Nature. June 18, 1903

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LXVII

NOVEMBER 1902 to APRIL 1903

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

THURSDAY, NOVEMBER 6, 1902.

LINEAR DIFFERENTIAL EQUATIONS.

Theory of Differential Equations. By A. R. Forsyth, Sc.D., LL.D., F.R.S. Part iii. Ordinary Linear Equations. Vol. iv. Pp. xvi + 534. (Cambridge: The University Press, 1902.)

IN this volume Prof. Forsyth deals with a part of his subject which, for many reasons, is full of interest. Ordinary linear differential equations concern the physicist, on the one hand, by their occurrence in the analysis required for many of his most important problems; on the other, they offer the pure mathematician an attractive field of research which appears to be almost inexhaustible.

Thanks to the contributions of a host of analysts, the theory of linear equations has now reached a high stage of development, and, as in other like cases, it is extremely interesting to see how different parts of it, which at first seemed isolated, are being gradually brought into organic connection. One of the first great steps in this direction was made by Gauss in his memoir on the hypergeometric series; this is another example of the extraordinary and almost uncanny way in which Gauss transformed and generalised every subject that he touched. It is as if his predecessors had been hewing stones for him to fit together into the lower courses of a stately building which he left for others to complete. And worthy successors have not been wanting, of whom, perhaps, Riemann is as yet the chief. For his brief memoir on the P-function marks an epoch by introducing several new notions of the very highest importance—the indices associated with the critical points, the analytical continuation of a branch of the function which satisfies the equation and the group of linear substitutions generated by describing cycles including critical points.

The real significance of Riemann's paper became fully evident only after the appearance of the celebrated memoir of Fuchs. It is, of course, impossible to say how Fuchs arrived at his discoveries; very likely he could not have explained his induction completely himself. In the introduction he refers to Briot and Bouquet as well as to Riemann, and acknowledges his obligations to Weierstrass. Fuchs deals with an equation of quite general order, the coefficients being functions of x with a limited number of singularities. He shows that in the neighbourhood of each critical point a there is a solution of the form $(x-a)^k\phi$, where ϕ is a one-valued analytical function and k is a constant determined by an equation which can be constructed from the differential equation itself. He also shows how the simplest independent solutions group themselves according to the multiplicities of the roots of the indicial equation.

The importance of these expansions near the critical points is that, besides giving us information about the analytical properties of the function defined by the differential equation, they enable us to investigate the group of substitutions associated with it. Suppose, for instance, we have an equation of the second order, and that in the neighbourhood of a there are two solutions of the form $(x-a)^h\phi$ and $(x-a)^k\psi$; if the independent variable starts near a and describes a small circuit round it, the solutions, by continuous variation, are multiplied by $e^{2\pi hi}$ and $e^{2\pi ki}$ respectively; thus with these solutions we have a substitution of the form $y'_1 = sy_1$, $y'_2 = ty_2$, where s, t are constants. When the indicial equation for a has multiple roots, the associated substitution is less simple, but can always be determined. If we start from *any* ordinary point with a set of independent solutions, then by Weierstrass's principle of continuation we can (in theory at least) follow up their values as x approaches a critical point a, then find the substitution which takes place as x goes round a, and finally bring back x to its original position. The effect of any closed circuit can thus be determined; and we have, on the whole, a group of linear substitutions, with generators corresponding to the critical points.

The singularities of an integral are determined by the coefficients of the differential equation; they may be poles or they may be essential singularities. One of the most remarkable things in Fuchs's paper is the determination of the form which a differential equation must have if all its integrals are regular in the neighbourhood

of each critical point; that is to say, if near any critical point a each integral can be put into the form

$$y = (x-a)^k \left\{ \phi_0 + \phi_1 \log(x-a) + \ldots + \phi_m [\log(x-a)]^m \right\}$$

where $\phi_0, \phi_1, \ldots \phi_m$ are one-valued functions not infinite at a. These equations are called by Prof. Forsyth "equations of Fuchsian type." The equation of the hypergeometric series is of this type, and is remarkable as being the only one, of order higher than the first, which is completely determined when the positions of the critical points and the indices associated with them are assigned.

An equation of Fuchsian type may have one or more algebraic integrals. If all the integrals are algebraic, the group of the equation must be finite; so here we have a most unexpected concurrence of two apparently disconnected theories. A very interesting problem is that of determining linear equations the groups of which are isomorphic with known finite groups; another is that of finding out whether a given equation has any algebraic integrals.

All the foregoing theory is discussed and illustrated by Prof. Forsyth in a very attractive and lucid manner; thus chapter i. deals with the existence of a synectic ntegral near an ordinary point and sets of independent integrals; chapter ii. with the expansions near a critical point and with Hamburger's method of grouping them; chapter iii. with regular integrals; chapter iv. with equations of Fuchsian type; and chapter v. with equations of the second and third orders possessing algebraic integrals. Illustrations are supplied by the familiar equations of mathematical physics, by the equation of the elliptic quarter-period, and by that of the hypergeometric series. It is delightful to see how the discussion of these equations is illuminated by the general theory.

After a chapter on equations w th only some of their integrals regular, we come to the consideration of integrals with essential singularities. The most familiar example of a function with an essential singularity at a finite place is exp (x^{-1}), which is the integral of $x^2y' + y = 0$; and it is easy to see that if P is any polynomial in x^{-1}, the expression expP has an essential singularity and satisfies a linear equation of the first order.

Suppose now that we find that a given equation has an integral with an essential singularity at the origin; it may be possible to express it in the form $\exp P . x^\rho \psi(x)$, where ρ is constant and $\psi(x)$ holomorphic. Such an integral has been called "normal"; the discussion of these integrals, and others obtained by putting $x^{1/k}$ for x, is given in chapter vii., which contains important results due to Thomé, Hamburger, Poincaré and others. There is also a brief account of "double-loop integrals" after Jordan and Pochhammer, and of Poincaré's theory of asymptotic integrals.

In his paper on the motion of the moon, Hill was led to the solution of a linear equation by a method involving the use of infinite determinants. In chapter viii. Prof. Forsyth discusses this method in some detail, after giving a preliminary account of infinite determinants and their properties. The subject of this chapter is not very attractive in itself, but on account of its practical importance has naturally attracted a good deal of attention.

Chapter ix. deals with equations with uniform periodic coefficients, and gives an account of this part of the subject which ought to encourage young mathematicians to read the original sources and experiment on their own account. It is, of course, the equations with doubly periodic coefficients that are most interesting. Thanks principally to Hermite, Halphen and Picard, some extremely beautiful results have been already obtained in this field, and there can be no doubt that others are awaiting discovery.

The last chapter of this volume, on equations with algebraic coefficients, must have been very difficult to write, and appeals mainly to the specialist. Its principal topic is Poincaré's celebrated theorem that the integrals of any linear equation with algebraic coefficients can be expressed by means of Fuchsian and Zetafuchsian functions. As Prof. Forsyth justly remarks, we cannot hope to make practical use of Poincaré's theorem until the analysis of automorphic functions has reached a higher state of development. To this end the treatise by Klein and Fricke, now in course of publication, will doubtless contribute largely.

In conclusion, it may be well to remark that this volume is in great measure independent of its predecessors, and that a great part of it will be quite intelligible to junior mathematicians provided that they know the elements of the theory of a complex variable. To them, therefore, as well as to their seniors, this book may be heartily commended. G. B. M.

SCIENTIFIC PSYCHOLOGY.

Grundzüge der physiologischen Psychologie. Von Wilhelm Wundt. Fünfte völlig umgearbeitete Auflage. Erster Band. Pp. xv + 553. (Leipzig: W. Engelmann, 1902.) Price 10*s*. net.

THIS volume of 553 pages is the first of the three volumes in which the fifth edition of Prof. Wundt's great work is to appear. The rapid increase in size of the work in each of the successive editions is thus maintained in the present one, and, as in the case of the previous editions, has been necessitated by the rapidity of the growth of the youngest of the natural sciences, experimental or, as Prof. Wundt prefers to call it, physiological psychology. And even the increase in bulk of this book does not by any means fully express the rate of growth of the science, a growth towards which this country has contributed so lamentably little. For the book is primarily a record of the work and the views of the author and of his pupils in the great Leipzig school. Nevertheless, Prof. Wundt has found it necessary to rewrite almost the whole of the book, so that, as he tells us, it must be regarded as almost a new one.

The greater part of this first volume is concerned with matters not strictly psychological, but rather with those studies which form an essential part of the equipment of the psychologist, namely, the fine and coarse anatomy, the embryology and the physiology of nervous tissues, both special and comparative. It is, perhaps, open to question whether it is wise to attempt to treat so vast a range of subjects in the scope of a single volume. For

the psychologist may be tempted to content himself with the cursory review that is alone possible in such a work. It should certainly be possible nowadays for the writer on psychology to assume on the part of his readers a competent knowledge of the gross anatomy of the nervous system and of the principles of the conservation of energy. (In the anatomical section occurs an error that is, perhaps, of the nature of a slip. In Fig. 79 and in the accompanying text the uncrossed fibres of the optic nerves are represented as going to the nasal sides of the retinæ. Now although v. Kölliker and others still maintain that the decussation of the optic nerve-fibres in the chiasma is complete, and although there is some ground for believing that there occur considerable individual variations in the proportion of crossed and uncrossed fibres, yet all authorities agree that the uncrossed fibres go to the temporal sides of the retinæ.) The propriety of including an account of the general physiology of nerves is less open to question, the less so as Prof. Wundt is here on his own ground and can speak with authority. In this section Wundt makes a timely protest against the uncritical acceptance and wholesale application of Hering's doctrine of assimilation and dissimilation now so common among physiologists, and yet he teaches somewhat dogmatically a view that differs but little from the one he rejects. He too groups together under the term "inhibition" (Hemmung) all phenomena to which it can in any sense be applied, and assumes that one and all are manifestations of constructive metabolic processes, thus affording one more instance of the fact that the study of logic cannot prevent a man forming illogical conclusions. It cannot be too frequently pointed out that we have no evidence of active inhibitory processes within the nervous system and that all the numerous cases of "inhibition" may, and in the present state of knowledge should, be regarded as cases of interference or prevention only. Wundt goes so far as to assume a differentiation of the bodies of nerve-cells into two parts, the anabolic inhibitory and the katabolic augmentor parts, and applies this hypothesis to the explanation of the valve-like nature of the paths of the spinal cord. But although the hypothesis seems to have been devised in order to explain this phenomenon, it is not by any means clear that it can be made to do so.

The discussions of the functions of the cortex and especially of the "speech-centres" are admirably thorough and suggestive, and here Wundt gives a great development to the conception of a "brain-centre." It is, perhaps, to be regretted that he retains the term "centre," for it properly expresses a crude conception of which the period of usefulness is now at an end.

In treating of the fundamental constituents of psychical processes, Wundt distinguishes two fundamental kinds of psychical element, the sensations and the feelings (Empfindungen und Gefühle), the former including all those that have an objective reference and that are determined directly or indirectly by stimulation of sensory nerve-endings both within and on the surface of the body, the latter being the purely subjective elements. Compounded of sensations is the presentation (Vorstellung) and of feelings the emotion (Gemüthsbewegung). Wundt thus sets aside the old distinction of sensation and idea as that which is excited from without and from within respectively, asserting that the distinction is purely logical and not at all psychological. Though we may admit that Wundt's use of the terms is a convenient one, yet it is impossible to follow him in denying the psychological character of the distinction usually made by English authors, or to admit his claim that the occurrence of hallucinations, which are purely pathological states, necessitates this denial. If the distinction were not psychologically valid, if we did not immediately recognise in the presentation the peculiar quality of reality that distinguishes it from the representation, the term hallucination would have no meaning.

Perhaps the most interesting part of the volume is the discussion of the "law of specific nervous energies." This principle Wundt would replace by one which he declares to be directly opposed to it, and which he describes as "the principle of the adaptation of the sensory functions to the stimulus and of the sensory apparatus to the functions." This is based upon and assumes the truth of the following principles: that of the original similarity of function of all nerve-elements, which Wundt establishes by tracing in a most interesting manner the differentiation of the various senses from the general sensibility of the amœba upwards; the principle of the adaptation of nerve-elements through use or habituation; and the possibility, which we seem compelled to assume in some cases, that nerve-elements may come gradually to discharge the functions of others when those others are in any way rendered incapable of functioning. Now, admitting that the "law of specific nervous energies," as set up by Johannes Müller and by Helmholtz, is not in any sense an explanatory principle, but merely a *résumé* of a large group of facts, and admitting that it demands genetic treatment such as Wundt supplies, yet it is not possible to admit that even the most complete account of the evolution of the specific differentiations of sense can abolish the truths of which this "law" is the summary expression; to account for the origin of a thing or belief is not necessarily to explain it away. The fact remains that any specialised nerve of sense, when subjected to stimuli whether normal or abnormal, leads only to the kind of affection of consciousness peculiar to that sense. Wundt's account of the adaptations of the senses to stimuli is admirable and no doubt true so far as it goes, but it is far from being a complete explanation of the genesis of the specific functions.

Reducing the problem to its simplest terms, suppose a primitive sense-organ to be affected in the same way by two classes of stimuli, say two rates of vibration of the circumjacent medium—and then suppose that either rate of vibration comes in the course of evolution to determine a differentiation of one part of the nerves of the organ, so that one set of nerves comes to respond in one way to the one vibration-rate only and the other set in another way to the other (or that all the nerves come to respond in two distinct ways), and suppose the difference of response to consist in a difference in rate of vibration of the substance of the nerves, or in a difference of propagated chemical changes. Up to this point we may accept Wundt's account of the differentiation-process as adequate. But when we inquire—How comes it that the soul reacts to these two vibration-rates (or two kinds of chemical change) with two different

qualities of sensation? then we find ourselves still completely in the dark. Wundt himself seems to have felt this inadequacy and to have introduced in consequence towards the close of his exposition a new factor, the "entgegen kommende Triebe des empfindenden Wesen." This introduction of the "feeling being" amounts, it would seem, to nothing more than an admission of our ignorance. And indeed we have here reached the very kernel of the problem of life, of that mystery of the relations of soul and body which has vexed the thinkers of all ages, of that "master knot of human fate" of which the Persian poet wrote eight hundred years ago

> "There was the door to which I found no key,
> There was the veil through which I might not see."

And these words remain equally true to-day, in spite of the splendid labours of Johannes Müller, of Fechner, of Wundt and of many others.

It is interesting to note that Wundt assumes the principle of the inheritance of acquired characters as absolutely necessary to the explanation of the evolution of the nervous system, and that in this he is in agreement with most of the psychologists who have considered the problem. For the principle of natural selection, which is so satisfactory when we are dealing with the neck of the giraffe or the protective colouring of a butterfly, seems hopelessly inadequate when we have to account for those million-fold coordinated details of nervous disposition which together determine in large part, if not wholly, the tendencies and character of a human being.

In the last section Wundt deals with Weber's law and maintains his well-known psychological interpretation of it, in opposition to the now very generally accepted physiological interpretation. The attention of English readers may be called to the novel and ingenious explanation suggested by Heymans in the *Zeitschrift für Psychologie*, Bd. 26. W. McD.

THE MODERN DYNAMO.

The Generators of Electricity at the Paris Exhibition of 1900. By C. F. Guilbert. Pp. iv + 766. (Paris: C. Naud, 1902.) Price 30 fr.

THERE were probably few who went to the Paris Exhibition two years ago who did not pay a visit to the Palais d'Électricité; and no one who did so can have failed to have been impressed by the enormous size of the electric generators exhibited there. We even know of feminine sightseers, on pleasure bent, sparing a few hours from the fascinating display of M. Worth to look at, and possibly learn a little about, the "purrin' dynamos." The massive grandeur of these magnificent machines, examples of the best design and workmanship of all nations; the complicated nature of their parts working in perfect harmony and smoothness, and obedient to the control of one or two men; their spotless cleanliness and the impression of reserved power which they conveyed; all these must have moved even the most matter-of-fact observer into sympathy with the ideas which inspired Mr. Kipling to write "M'Andrew's Hymn." Such a collection merited the permanent record which it has obtained in the pages of M. Guilbert's book. Something of the spirit of the machines which he describes seems to have entered into the author, for his book, like the dynamos, is very large. There are nearly 800 pages, with, to use the author's own words, "615 engravings and plans, of which 118 plates." M. Guilbert has adopted a somewhat novel plan with the laudable desire of making his book attractive to foreign readers. The title pages and preface are in the language of the country in which the copy is to be sold; the chapter and section headings, the descriptions of the illustrations and the tables, are given in French, German and English. We rather doubt the wisdom of this innovation, since it increases the size of a volume already bulky, and still the most important part, the text, remains only in French. The result of the translation, too, is apt at times to be rather humorous, as, for example, when the author translates *résumé* (which the mere Englishman is content to use in the original French) into a non-existent English equivalent.

Criticism of a book of this kind is almost out of the question. M. Guilbert begins by describing the system of classification which he has adopted, and then, taking each division in turn, gives a more or less detailed description of the principal exhibits which come within it. Photographs of the generators and clearly executed diagrams of the whole machine or of important details greatly help out the letterpress. The book is therefore, in a way, like a descriptive catalogue, but it is one which gives a large amount of very valuable information, and M. Guilbert deserves great credit for the painstaking way in which he has collected and the clear manner in which he has arranged the data supplied by the manufacturers. It may be objected that the work is two years out of date and that the machines of 1900 are almost ready for the scrap heap in 1902. But rapid as the advance of electrical engineering is, there are few engineers who will not benefit to-day by the careful study of what was best two years ago, especially as it is the best, not of one country only, but of all countries; there will be many also interested in the design and improvement of electric generators who will desire to possess this book, even though it should become in the course of a few years of historical interest only.

As we turn over the pages of M. Guilbert's book, we find difficulty in selecting any particular machine for special notice. As the most noticeable feature in dynamo development in recent years has been the steadily increasing size of the unit, we may perhaps be pardoned if we pick out one of the largest machines exhibited at Paris. The Allgemeine Elektricitäts Gesellschaft exhibited a three-phase alternator of 4000 h.p. The output of this machine was 3000 kilovolt-amperes with a power factor of 0·9, making 2700 kilowatts. This alternator is one of a set of twenty-two, eight of which are already installed at the Berlin Electricity Works, the remaining thirteen being under construction. To bring this machine to Paris and to erect it in the German annexe, where there was no travelling crane, was a work of no small difficulty. The total weight was 160 tons, the armature frame weighing 80 and the field magnet 70 tons, the remaining 10 tons being due to the bedplate. The armature and field magnet were brought to the exhibition in quarters, each quarter being carried mounted between two railway trucks in the position most suited

for its subsequent erection. The whole work of erection was successfully completed in three weeks.

The A.E.G. alternator was not in actual operation at Paris, but was rotated for exhibition purposes by a small motor. An equally large generating set was exhibited by the Helios Company, driven by a triple-expansion engine and used for the lighting of the exhibition. This machine was of special design, as the makers desired to satisfy the requirements of the exhibition authorities and also to make the alternator suitable for subsequent disposal for other purposes. Another alternator of special interest was that exhibited by the Société l'Éclairage Électrique, which generated at 30,000 volts. This was designed more as an experimental machine, to show the possibility of directly generating at very high pressure and so dispensing with step-up transformers. The alternator had only an output of 180 k.v.-a. It is interesting in this connection to recall that last February Messrs. Schuchert and Co. completed three 1500 kw. three-phase alternators generating at 20,000 volts, for supplying power to the Valtellina Railway.

M. Guilbert has collected together all the chief data of the various machines in ten tables as an appendix at the end of the book. There is also given as an appendix a series of twenty oscillograph curves showing the potential wave-forms of a number of the alternators. These, which were taken by means of M. Blondel's oscillograph, though very interesting, are hardly accompanied by sufficient data to make them of great value. A casual inspection is, however, sufficient to show that, as M. Guilbert remarks, much progress remains to be made in the construction of alternators before a practically sinusoïdal potential-curve is obtained. Yet though much remains to be done, much has already been accomplished, and the manufacturer of the modern dynamo has nothing of which to be ashamed. His machines are efficient, and he has shown that he is capable of making them of a size suitable to the ever-increasing requirements, and there can be little doubt that when the time arrives he will be able to meet still greater demands. It is not likely to be long before these are made, especially for generators for traction work. But a year or two ago the Westinghouse Company built two 2700 kw. generators for the Boston Elevated Railway; one is inclined to ask what the size of the units will be when, say, the London and North-Western or the Canadian Pacific Railway is run electrically. We can only hope that it will not be long before an answer has to be given to his question; that our progress in the future will be as rapid and as sound as it has been in the past; and that the next seventy years will be as full of development and improvement as have been the seventy which have passed since Faraday "did not despair of being able to construct a new electrical machine." M. S.

OUR BOOK SHELF.

Thirteenth Annual Report of the Local Government Board, 1900–1. Supplement containing the Report of the Medical Officer for 1900–1. (London: Eyre and Spottiswoode, 1902.)

THE scientific memoirs contained in this volume are of considerable interest. Drs. Klein and Houston have investigated the behaviour of pathogenic organisms when inoculated upon various farinaceous media, and conclude that the likelihood of infection of the human subject from such source is probably remote. A number of food-stuffs were similarly examined by Dr. Klein for the presence of pathogenic organisms, with the result that none was found. Dr. Gordon has continued his studies upon the bacteriology of scarlatina, and he adduces further proof that the *Streptococcus scarlatinae* is a species distinct from other streptococci and that it may be the causative organism of this disease. Two papers are concerned with the behaviour of micro-organisms when inoculated into the soil. In the first, Dr. Houston inoculated soil with crude sewage, and found that on the whole the soil-microbes ousted the sewage ones and that the addition of sewage to soil resulted in a temporary increase only of the sewage microbes. In the second, Dr. Sidney Martin has continued his work upon the nature of the antagonism of the soil to the typhoid bacillus; this organism survives but a short time in the soil, being destroyed by the products of the putrefactive bacteria which exist therein. Dr. Klein also reports on the infection of cockles and mussels with the typhoid and cholera microbes, and shows that these organisms may persist in the interior of the molluscs for some time after the source of infection has been removed. The importance of rats in the dissemination of plague has induced Dr. Haldane to devise an apparatus for generating carbonic oxide gas for destroying these pests in plague-infected ships. This is described and some experiments with it are detailed. There is also an interesting report upon research work in connection with glycerinated vaccine lymph. The volume concludes with a number of well-executed photographs illustrating the various papers. R. T. HEWLETT.

The Flora of the East Riding of Yorkshire. By J. F. Robinson. Pp. vii + 253. (London: A. Brown and Sons.) Price 7*s.* 6*d.*

THE "Flora of the North Riding of Yorkshire," compiled by Mr. J. G. Baker so long ago as 1863, furnishes a delightful account of the plants and the plant-associations of that division. Dr. F. A. Lees is responsible for a "Flora of the West Riding" which is equally successful. The present work, therefore, fills up an important gap and completes the botanical survey of the county. The enumeration of plants is preceded by a historical review of earlier compilations and a series of sketches referring to the physiography, meteorology and plant distribution of the district. These, taken in combination with the geological map, add greatly to the interest of the book. At the same time, these chapters seem capable of some improvement. The physiographical chapter brings out very clearly the interesting features of the division, the ancient lake-area now represented by a single lake and patches of marsh in the plain of Holderness, the estuary of the Humber, the Cretaceous formation of the Wolds and the mixed character of the deposits in Derwent-land. But the ecological chapter suffers by being too condensed, and "xerophiles," "pelophiles," "arenophiles" are tumbling over one another. The contrast of "xerophiles" and "pelophiles" on pp. 35, 39, represents a confusion of terms. A more detailed and localised account of the plant forms on the different alluvial deposits and an extension of the very brief indication of successive littoral colonies, as well as fuller descriptions of other local formations, might well be given, and the extra space could be more than gained by a less generous use of type and spacing in the flora proper. In the enumeration of plants, the author and his colleagues have endeavoured to sift out the aliens which are especially abundant round Hull Docks, and also the recorded localities have received personal confirmation as far as possible. The author and the Hull Scientific and Field Naturalists' Club deserve the thanks of botanists for a

compilation which represents much hard work and which will serve to stimulate interest in that division of the county, inasmuch as it indicates a somewhat unexpected wealth and variety of plant forms. Mr. J. J. Marshall has furnished a list of the mosses of the Riding.

A Revolution in the Science of Cosmology. By George Campbell. Pp. 210. (London: Sampson Low, Marston and Co., Ltd., 1902.)

IN spite of the author's description of himself as "a professor and teacher of the natural sciences for many years," this attempt to revise the generally accepted theory of planetary evolution shows a very imperfect acquaintance with scientific principles. The leading idea is that the earth was never in a molten condition, but is now undergoing the process of fusion in consequence of the pressure of the external strata on the interior mass. The sun also is declared to have once been an opaque body, and to represent more or less what the earth and other planets will become. In this connection it is only necessary to point out that while a gaseous mass contracting under the influence of its own gravity will rise in temperature, there is no ground for extending this principle to masses which are liquid or solid.

Among the other unacceptable ideas met with is that which accounts for a prehistoric change in the polar climate by supposing that the North Pole of the earth was "suddenly" turned from the sun and remained in that position for ages, having ceased for the time being to rotate on its axis (pp. 35 and 140). Again, on p. 64, speaking of the Whirlpool nebula, it is stated that "the violent agitation of the mass must result in a very low temperature," whereas a high temperature would be expected.

The author appears to have a vague idea that electricity plays an important part in the development of worlds, and that "atoms of interstellar space" represent the primary state of all matter, but he makes no contribution of value to the subject.

The Reliquary and Illustrated Archaeologist. Edited by J. Romilly Allen. Vol. viii. Pp. 287. (London: Bemrose and Sons, Ltd., 1902.) Price 12*s.* net.

STUDENTS of any branch of archæology will find something to interest them in this volume. The periodical, of which the numbers issued during the present year are included in the volume, is "a quarterly journal and review devoted to the study of the early pagan and Christian antiquities of Great Britain; mediæval architecture and ecclesiology; the development of the arts and industries of man in the past ages; and the survivals of ancient usages and appliances in the present." Notes on interesting and important papers contributed to some of the separate numbers of the *Reliquary* have already appeared in these columns, so that it is only necessary to say here that the eighth volume, with its numerous, well-produced illustrations, would make a handsome addition to the library of the student of antiquities.

Earth and Sky. A Second and Third Grade Nature Reader and Text-Book. By. J. H. Stickney. Pp. viii + 118. (Boston, U.S.A., and London: Ginn and Co., 1902.) Price 1*s.* 6*d.*

THIS is a reading book for young children. Its object is, the author says in his preface, "to bring before children's minds their own relation to the natural world in such a way as to appeal to imagination and reflection." The lessons will probably prove interesting to those for whom they are intended, but they do not sufficiently encourage the child's own activity. It is not enough to tell young pupils about natural objects; they should be encouraged to observe for themselves, instead of being content with the descriptions of others.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Waste of Energy from a Moving Electron.

THE subject of the dynamics of a moving charge being of considerable interest now, I have thought the following may be useful. I have shown that a charge Q on a sphere of radius A, when suddenly jerked into motion at speed u, generates a spherical electromagnetic shell of depth 2A, in which the magnetic force H tends to the value given by

$$2AH = \frac{Q}{4\pi R} \frac{u \sin\theta}{1 - \frac{u}{v}\cos\theta}, \qquad (1)$$

when R, the distance from the initial centre of Q, is great. Along with this H, we have perpendicular electric force in the shell, according to $E = \mu v H$, or vectorially, $\mathbf{E} = V\mathbf{vB}$, if $\mathbf{v}$ is the vector velocity of the shell. The angle θ is that between $\mathbf{u}$ and $\mathbf{R}$. The energy wasted by this shell equals the energy left behind, that is, $U - U_0 + T$, if U_0 is the initial, U the final electric energy in the field, and T the final magnetic field energy. On its first formation, $\mathbf{H}$ and $\mathbf{E}$ in the shell are different; they then include in accumulated form all the $\mathbf{H}$ and $\mathbf{E}$ which are left behind by the shell as it expands. The applied force impulse follows from my formula for the force on the ether, viz. $\mathbf{F} = (d/dt)V\mathbf{DB}$ per unit volume. Denoting the time integral by $\mathbf{M}$, then $\mathbf{M} = \mathbf{M}_1 + \mathbf{M}_2$, where $\mathbf{M}_2$ belongs to the shell ultimately, and is lost, whilst $\mathbf{M}_1$ is left behind in the field. We have $T = \frac{1}{2}M_1 u$ and $U - U_0 = \frac{1}{2}M_2 u$; so that altogether

$$\tfrac{1}{2}Mu = U - U_0 + T. \qquad (2)$$

Both $\mathbf{M}_1$ and $\mathbf{M}_2$ are parallel to $\mathbf{u}$.

If, now, a second impulse acts, changing the velocity from $\mathbf{u}_1$ to $\mathbf{u}_2$ say, another spherical shell is generated. Disregarding the part left behind, (1) above shows that the magnetic force in it is

$$2AH = \frac{Q}{4\pi R}\left(\frac{u_2 \sin\theta}{1 - \frac{u_2}{v}\cos\theta} - \frac{u_1 \sin\theta}{1 - \frac{u_1}{v}\cos\theta}\right), \qquad (3)$$

when the direction does not change. More generally, substitute the vector change in the quantity on the right side of (1) properly vectorised. Then the change in θ will be allowed for as well.

The energy lost in this second shell may be calculated by (3). It amounts to

$$\left\{\frac{u_2 P_2 - u_1 P_1}{u_2 - u_1}\left(1 - \frac{u_1 u_2}{v^2}\right) - P_0\right\} Q, \qquad (4)$$

where P is the potential function

$$P = \frac{Q}{4\pi Ac}\left(1 + \frac{1}{3}\frac{u^2}{v^2} + \frac{1}{5}\frac{u^4}{v^4} + \ldots\right) \qquad (5)$$

investigated by Searle and Morton. Take $u = 0$, u_1 and u_2 to obtain P_0, P_1, P_2. It may be shown that the substitution of two impulsive changes in the same direction for a single one reduces the waste; that is, the one impulse u_2 wastes more energy than the two successive impulses u_1 and $u_2 - u_1$. In fact, the saving is great, and ten equal partial impulses in succession waste not much more than one-tenth part of that wasted by a single impulse of size equal to their sum. There is a residuum, however, and that is what appears as continuous waste when u varies continuously.

When Δu is small

$$2AH = \frac{Q}{4\pi R} \frac{\sin\theta\,\Delta u}{\left(1 - \frac{u}{v}\cos\theta\right)^2}, \qquad (6)$$

and now the waste of energy in the shell wave corresponding to Δu is

$$\frac{\mu Q^2}{12\pi A} \frac{(\Delta u)^2}{\left(1 - \frac{u^2}{v^2}\right)^2}. \qquad (7)$$

The magnetic force in the above shells is uniform in the depth of the shell, when the impulse acts strictly at the front of a shell.

But if Δu be distributed uniformly over the time $2A/v$, the shell will be doubled in depth, and H will rise at uniform rate from 0 to the same full value in the middle of the shell and then fall similarly to zero in the second half. Now if a second equal Δu acts in the same way, beginning as soon as the first Δu has made H reach full strength, H will continue of that full strength. And so on with a third Δu. Finally, if $2A = v\Delta t$, and $\Delta u/\Delta t$ is steady, and allowing for the variable depth of the shell according to (11) below, we come to

$$\Delta t \cdot \frac{\mu Q^2}{6\pi v}\left(\frac{\Delta u}{\Delta t}\right)^2 \frac{1}{\left(1-\frac{u^2}{v^2}\right)^3}, \tag{8}$$

to represent the waste in time Δt. Or, if W is the rate of waste

$$W = \frac{\mu Q^2}{6\pi v}\left(\frac{du}{dt}\right)^2 \frac{1}{\left(1-\frac{u^2}{v^2}\right)^3}. \tag{9}$$

This holds when the acceleration and the velocity are parallel. By the manner of construction, it is necessary that du/dt should not vary sensibly in the time taken by light to traverse the diameter 2A.

By a fuller analysis, allowing for change of direction of motion, I find that the waste of energy per second from a charge Q with velocity **u** and acceleration **a** is

$$W = \frac{\mu Q^2 a^2}{6\pi v} \frac{1 - \frac{u^2}{v^2}\sin^2\theta_1}{\left(1-\frac{u^2}{v^2}\right)^3}. \tag{10}$$

when θ_1 is the angle between the velocity and acceleration (absolute). The dimension A does not appear. W is the same for any size, subject to the restriction mentioned. The smaller A the better, of course. It is exactly true with $A = 0$, only then the motion would be impossible.

This calculation of the waste may be confirmed by following up my investigation of the electric and magnetic field by the method I gave in 1889 ("Elec. Pa.," vol. ii. p. 504).

The waste is greatest when the velocity and acceleration are parallel, and least when perpendicular. There is another reservation, viz. u must be less than v. If not, special treatment is required, after the manner I have already published.

The meaning of waste is this. When Q moves through the distance udt, it casts off a spherical shell of depth

$$\frac{vdt}{1 - \frac{u}{v}\cos\theta} \tag{11}$$

and the energy of this shell when it has gone out to an infinite distance is Wdt.

When at a finite distance, **E** and **H** in this elementary shell are given by

$$\mathbf{E} = \mathbf{E}_1 + \mathbf{E}_2, \qquad \mathbf{H} = \mathbf{H}_1 + \mathbf{H}_2,$$
$$\mathbf{H}_1 = \mathrm{V}\mathbf{u}\mathbf{D}_1, \quad \mathbf{H}_2 = \mathrm{V}\mathbf{v}\mathbf{D}_2, \tag{12}$$

$$\mathbf{E}_1 = \frac{Q}{4\pi R^3 c}\, \frac{\mathbf{R} - \frac{\mathbf{u}}{v}R}{\left(1 - \frac{u}{v}\cos\theta\right)^3}. \tag{13}$$

$$\mathbf{E}_2 = -\frac{\mu Q}{4\pi R}\left\{\frac{\mathbf{a}}{\left(1-\frac{u}{v}\cos\theta\right)^2} - \frac{a\left(\mathbf{R} - \frac{\mathbf{u}}{v}R\right)\cos\phi^1}{\left(1-\frac{u}{v}\cos\theta\right)^3}\right\}. \tag{14}$$

Here the part $\mathbf{E}_1$, $\mathbf{H}_1$ belongs to the steady travelling state of steady **u**, whilst the other part $\mathbf{E}_2, \mathbf{H}_2$ is electromagnetic, and represents the waste. The angle between the acceleration **a** and **R** is ϕ^1. The waste part has $\mathbf{E}_2, \mathbf{H}_2$ tangential, that is, perpendicular to **R**. $\mathbf{H}_1$ is also tangential to the sphere, but $\mathbf{E}_1$ is radially directed from the point which Q would reach at the moment in question (belonging to the sphere R) if it were not accelerated at all. This means the steady travelling state (see "El. Pa.," vol. ii. p. 511, equation 29). There is another way of treating the question, viz. by the vector and scalar potentials. The vector potential of the impressed current $Q\mathbf{u}$ is not $Q\mathbf{u}/4\pi R$, but (*loc. cit.*)

$$\mathbf{A} = \frac{Q\mathbf{u}}{4\pi R\left(1 - \frac{u}{v}\cos\theta\right)}. \tag{15}$$

This is referred to origin at the virtual position of the charge, not the actual. The actual is best for the steady state, the virtual to show the waves emitted. The factor $(1 - u/v\cos\theta)^{-1}$ expresses the Doppler effect. Divide by $\mathbf{u}c$ to obtain the scalar potential Φ. Then

$$\mathbf{H} = \text{curl } \mathbf{A}, \qquad \mathbf{E} = -\mu\dot{\mathbf{A}} - \nabla\Phi$$

in Maxwell's manner. The trouble here is the differentiations, which require great care, since **u**, **R** and θ all vary in a rather complicated way as Q moves. The relations (12) exhibit the field clearly.

For an infinitely small sphere of Q, the energies in the shell at distance R corresponding to the displacement udt of Q are

$$T = T_1 + T_2 + 2T_{12},$$
$$U = U_1 + U_2 + 2U_{12},$$

where $_1$ relates to the $\mathbf{E}_1\mathbf{H}_1$ part and $_2$ to the other part, whilst $_{12}$ refers to the mutual energy. They are connected thus:

$$U_2 = T_2, \quad U_{12} = T_{12}, \quad U_1 = T_1 + \frac{Q^2 vdt}{8\pi R^2 c}, \tag{16}$$

$$T_1 = \frac{Q^2 vdt}{12\pi R^2 c}\,\frac{u^2/v^2}{\kappa^2}, \quad T_{12} = \frac{\mu Q^2 a}{12\pi R}\,\frac{udt\cos\theta_1}{\kappa^4}, \tag{17}$$

$$T_2 = \frac{\mu Q^2 a^2 dt_1}{12\pi v}\,\frac{1 - \frac{u^2}{v^2}\sin^2\theta_1}{\kappa^6}, \tag{18}$$

where $\kappa^2 = 1 - u^2/v^2$.

The corresponding "momenta," or force-impulses, say $\mathbf{M}_1 = \Sigma\mathrm{V}\mathbf{D}_1\mathbf{B}_1$, $\mathbf{M}_2 = \Sigma\mathrm{V}\mathbf{D}_2\mathbf{B}_2$, $\mathbf{M}_{12} = \Sigma\mathrm{V}\mathbf{D}_1\mathbf{B}_2$, $\mathbf{M}_{21} = \mathrm{V}\mathbf{D}_2\mathbf{B}_1$, are given by

$$\mathbf{M}_1 = \frac{2T_1}{\mathbf{u}}, \quad \mathbf{M}_2 = \frac{2T_2\mathbf{u}}{v^2}, \quad \mathbf{M}_{21} = \frac{2T_{12}\mathbf{u}}{v^2}. \tag{19}$$

These are all parallel to **u**. But $\mathbf{M}_{12}$ is not, though it is in the plane of **u** and **a**. Its components parallel to **u** and to **a** are

$$\frac{2T_{12}}{u}, \quad\text{and}\quad \frac{2T_{12}}{u}\,\frac{1 - \frac{u^2}{v^2}\sin^2\theta_1}{\cos\theta_1}. \tag{20}$$

With the previous restriction, these are independent of the size of the sphere of Q. But to obtain exact formulæ without this restriction, either a very difficult integration must be effected over the surface of the sphere of Q, every element of which will usually have (effectively) a different velocity and acceleration, on account of the Doppler effect, or we may derive the resulting formulæ by a differentiating operator. Thus, for example, exhibiting it for Φ only, let Φ_0 be the formula when $A = 0$, then the real Φ is, by a previous investigation,

$$\Phi = \frac{\text{shin } qA}{qa}\Phi_0, \tag{21}$$

outside the sphere, and

$$\Phi = \frac{\text{shin } qr}{qr}\Phi_{0A}, \tag{22}$$

inside the sphere, where q is the differentiator $d/d(vt_1)$ and Φ_{0A} is the common value of both Φ's at $R = A$. But this t_1 is not the same as the previous t; it is the corresponding value; the place where the differentiations are performed is at the end of **R**. The differentiations are troublesome. Thirdly, we may calculate the time integral of Φ_0, and then apply Taylor's theorem. Nearly all the trouble in the electronic theory is connected with the necessity of making A finite to have finite energy (though this does not apply to the waste) and finite moving forces, with the consequent resulting two superposed waves, one outward from the surface of Q, the other inward, and then outward again. The results for impulses work out easily enough, but not for continuous accelerations.

Details of the above will be published in vol. iii. of "Electromagnetic Theory" (and perhaps elsewhere), which is, as the advertisement says, "in preparation."

Returning to the waste formula, an electron revolving in a circle of radius r has $\theta_1 = \frac{1}{2}\pi$, and $u^2/r = a$. So we want an applied force along **u** varying as u^3 to maintain the motion, since the waste varies as u^4. This revolving electron has sometimes been supposed to be a circular current. But it is really a vibrator. The free path followed under decay of energy without fresh supply would perhaps be difficult to follow

completely. It is rather hard for the "explanation" of magnetism.

The kinetic energy of molecules is the natural source of the radiation, but the connection between them and the electrification is very obscure, and how the electrons get knocked off is harder still, and what they are is hardest of all. Larmor thinks they run through the ether like knots on a string. If they do, as they may, *how* do they do it? Connections are wanted.

OLIVER HEAVISIDE.

Leonid Meteors, 1902. A Forecast.

THE historical interest which attaches to the Leonid star showers naturally renders the near approach of mid-November a subject of paramount importance to meteor observers. Nor is expectation lessened on the present occasion by the moderate though somewhat unexpected brilliance of the Leonid display witnessed last year in America on the morning of November 15. The question must naturally occur to many, will there be a revival of the phenomenon in the November of 1902, and if so, will it make its appearance in a less or a more intensified form than in the previous year? Generally speaking, the prospects of a star shower on the night of November 15 this year are very good. An analysis made by the writer of the conditions under which last year's shower appeared, and also of those connected with the more brilliant meteoric spectacles of the past, shows that the event of November 15, 1901, is likely to be much surpassed by the meteoric phenomenon of 1902. The display falls due on the night of November 15 on the present occasion, and not on that of November 14 as was the case last year and was duly predicted by the writer (*Daily Chronicle*, November 14), though the maximum occurred somewhat later on that night than had been expected. The first phase of the shower will take place, however, at an hour not very well suited for its observation in western Europe, the time of its maximum being November 15d. 10h. 45m. G.M.T., when the radiant will be not much more than just above the horizon. Meteors from a radiant in full activity as it emerges above the horizon afford an interesting spectacle, however, and though their numbers must in consequence be seriously diminished, they somewhat atone for their paucity by often long and rapid flights across the heavens. This first appearance of the shower will of course be best observed in places situated at least a few hours to the east of Greenwich, though it ought not to escape observation in our less favoured localities. This early display promises to vie in brilliancy with that observed on the western slopes of the Pacific in 1901, if atmospheric conditions turn out favourable in those places best suited for its observation on the night of November 15, and in all places where the radiant will be above the horizon at the time of its maximum it ought to render shooting stars pretty abundant during the early hours of that night.

The second maximum of the Leonid display has been calculated to take place on November 15d. 18h. 45m., and promises to be the richest display of the night, though the time of its highest brilliancy will scarcely enable observers to obtain the most satisfactory view of it on this side of the Atlantic, as the increasing twilight between six and seven o'clock in the morning must somewhat impede observation. Along the eastern coast of America, on the other hand, the shower is likely to prove an attractive spectacle to observers, and its full strength can better and more accurately be subjected to calculation than with us, as its maximum will occur there at about two o'clock (local time) on the morning of November 16. Though that hour is rather early for its best observation, as the Leonid radiant is most favourably situated for purposes of meteoric observation in any place at about 4 o'clock in the morning (local time), yet on the present occasion at no other place can a better and more systematic watch be maintained for the anticipated star shower than along the Atlantic side of the American continent. Passengers on vessels crossing the Atlantic will no doubt find themselves specially favoured with opportunities for observing the phenomenon, as has been the case in previous star showers, such as that of 1868. The calculations made with respect to this meteor display go to prove that it will decline rather rapidly after 18h. 45m. on the night of November 15, the maximum showing a tendency to occur rather before th n after the time indicated, and on this account shooting stars are very likely to appear in unusual numbers to European observers throughout the night in question. As has been already stated, the shower expected in the present year gives considerable promise of surpassing in intensity that of 1901. Indeed, the calculated strength of the former is from ten to fifteen times that of the latter, but the presence of a full moon throughout the night of November 15 has not been taken into account in the determination of the foregoing comparison, and this circumstance must detract considerably from the relative splendour of the meteoric epoch of the present year. The full moon will probably obliterate the close of this year's shower, the end of which has been timed to take place on November 16d. 2h. 30m., and is generally of too weak a character to require any special consideration. It may be added that the foregoing calculations have been based on the assumption that the maximum of the Leonid shower of 1866 occurred at 1h. 15m. on the morning of November 14, G.M.T.

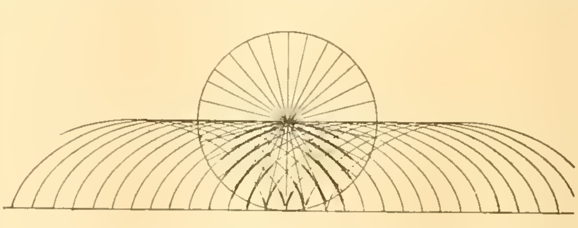
JOHN R. HENRY.

20 Rathmines Road, Dublin, November 3.

Curvature of Wheel Spokes in Photographs.

MANY people must have noticed the curious curved appearance presented in a photograph by the spokes of a moving vehicle. It is well known that the envelope of a diameter of a circle rolling along a straight line is a cycloid of half the dimensions of the cycloid traced by a point on the circumference. The part of the moving spoke which makes the strongest impression on the photographic plate will be where it intersects the consecutive position, so that the photograph really gives us

a small piece of the envelope of each spoke. The effect may be compared to the ordinary caustics of reflection or refraction. The accompanying photograph shows, not only the curvature of the spokes, but also the cusps of the envelopes of the spokes the ends of which have touched the ground during the exposure. In the diagram, the envelopes for a circle with fourteen equidistant diameters are drawn, and the parts of the envelopes which have



been put in strongly indicate the appearance that would be presented in a photograph, supposing that three spokes had touched the ground during the exposure. The spokes on the upper half of the moving wheel leave no impression on the plate, because their points of ultimate intersection lie *outside* the spokes themselves.

R. M. MILNE.

Royal Military Academy, Woolwich, S.E.

The Turkestan Earthquake of August 22.

INFORMATION received in India leaves no room for doubt that the earthquake of August 22, which left such conspicuous traces on the seismographs of Europe, had its origin in Central Asia. The representative of the Indian Government at Kashgar reports that there was a severe earthquake there at 8 a.m. on August 22, which lasted one-and-half minutes. Repeated

shocks were felt throughout the day, and shocks are reported on every day up to August 30. At 10 p.m. on September 2, a very sharp and severe shock was felt. It is said, though this has probably no direct connection with the earthquake, that the disturbance was followed by extreme heat, which lasted, at any rate, to the end of the month.

At Kashgar a good number of walls, made of sun-dried bricks, were knocked down, but masonry buildings do not seem to have suffered; sixteen deaths are said to have occurred through falling of houses. In the Artush district, to the north of Kashgar, the damage was much greater; nearly all the houses—presumably built of sun-dried brick—are said to have collapsed, and 667 deaths are known, besides more than 1000 persons severely injured. In Russian territory north of the Tian Shan range the shock appears to have been less violent, and it is reported that the damage done at Narin and Atbashi was not great. In the opposite direction the shock was felt at Yarkand, whence three shocks are reported to have been felt between 9 and 10 a.m. Some damage was done to the city wall and some private buildings; two children were killed by walls falling on them.

These particulars are sufficient to show that the earthquake was one of the first order of magnitude. Yarkand and Narin, at both of which it was destructive, are about 240 miles apart in a straight line, but are not sufficient to determine with certainty the position of the epicentre. This was evidently either to the east-north-east of Kashgar or more probably to the west-north-west among the mountains of the Alai Tian Shan range. It may consequently be taken that this earthquake, which will probably never be the subject of a detailed study, originated in about lat. 40° N., long. 74° E. of Greenwich.

Calcutta. R. D. OLDHAM.

Lectures on Anthropology and Ethnology.

THE letter of "Anthropotamist" in your issue of October 30 ought to meet with general approval.

In mentioning the educational institutions at which anthropology and ethnology are taught, your correspondent has entirely omitted London.

May I point out that courses of lectures in these subjects have been established at this college for the past two years, and have been attended by upwards of thirty students? Of these, two have previously contributed papers to the *Philosophical Transactions* and *Biometrika* dealing with questions of physical anthropology, while a third is the author of a volume treating of one phase of ethnology. It may be fairly claimed that to this college belongs the credit of being a pioneer in the systematic teaching of this subject in London.

H. W. MARETT TIMS.

Bedford College for Women (University of London), November 2.

THE ROYAL SOCIETY'S CATALOGUE OF SCIENTIFIC PAPERS.

THE following memorandum has been issued by the treasurer of the Royal Society:—

The Royal Society has been engaged continuously during the past forty years in cataloguing the various scientific papers which have been issued in all parts of the world since the beginning of the last century. The original scheme of the Catalogue of Scientific Papers provided that the papers should be catalogued only under the names of their respective authors arranged alphabetically. This "Authors' Catalogue" has now been carried down to the end of 1883, and comprises twelve quarto volumes.

More recently it has been decided to prepare also a subject index of the same papers, that is to say, a catalogue in which the papers are indexed according to the subject-matter of which they treat. Considerable progress has been made with this subject index, though nothing has as yet been published.

The expense of this work has been very large; since, although a great amount of gratuitous labour has been readily given by Fellows of the Society, it has been necessary to employ a considerable permanent salaried staff upon the preparation of the copy for the press. At first the printing and publication were undertaken by H.M. Stationery Office, the Treasury having determined that the Catalogue should be printed at the public expense. In coming to this conclusion, the Lords of the Treasury stated that they had regard "to the importance of the work with reference to the promotion of scientific knowledge generally, to the high authority of the source from whence it came, and to the labour gratuitously given by members of the Royal Society for its production." This arrangement, however, came to an end after the publication of the first eight volumes. The Treasury, in 1889, informed the Society that the Catalogue could no longer be printed and published by the Stationery Office. The unsold volumes were, however, handed over to the Society, and Parliament voted a sum of 1000*l.* to assist the Society in continuing the printing and publication. The four subsequent volumes have been printed and published by the Cambridge University Press, which has received subsidies from the Society for this purpose and receives the sums arising from sales.

The total sum expended by the Society upon the Catalogue down to the end of June last has been 14,790*l.* 5*s.* 5*d.* Towards this expenditure a donation of 2000*l.* was made by Dr. Ludwig Mond in 1892. Sums amounting to 524*l.* 11*s.* 9*d.* have been received as the proceeds of sales of the volumes handed over to the Royal Society by the Stationery Office, and, as already stated, 1000*l.* has been received from the Treasury. The Council has also hitherto devoted the income of the Handley fund (which they have power to apply as they may deem best for the advancement of science) towards defraying the cost of producing the Catalogue. The total sum received from this source has been 2394*l.* 11*s.* 10*d.* A sum of 341*l.* 11*s.*, arising from money invested until actually required, has also been available for the same purpose. These pecuniary aids amount in all to 6260*l.* 14*s.* 7*d.* As will be seen, they have not been nearly sufficient to meet the whole cost, and the Society has been compelled to make up the balance of 8529*l.* 10*s.* 10*d.* out of its general income.

As it became obvious that to continue permanently to prepare and publish catalogues of the ever-increasing stream of scientific literature was wholly beyond the means of the Society, the Council took steps to obtain international cooperation in this great work. Such cooperation has happily been secured, and the cataloguing of the scientific literature of the present century is now in the hands of an international council. The Royal Society has, however, incurred large special responsibilities in connection with the matter, having undertaken, *inter alia*, to act as the publishers of the Catalogue, and also to advance the capital required to start the enterprise.

The International Catalogue is concerned only with the scientific literature appearing after the commencement of the present century. The Royal Society's Catalogue, as already stated, is at present carried down to the end of the year 1883 only, and the subject index for that period is but partially dealt with. The foreign delegates, assembled to consider the establishment of the international council, expressed their sense of the great importance of the Royal Society's Catalogue and of the obligations which men of science in all countries were under to the Society for having undertaken it. They also expressed the hope that the Society would complete the Catalogue up to the close of the last century, so as to bring it into line with the International Catalogue.

In order to complete the Catalogue, it will be necessary to prepare and publish a catalogue of authors for the seventeen years 1883–1900, and to complete and publish the subject index for the whole of the past century. The Council of the Royal Society are satisfied that this work must be done, and have not felt justified

in refusing to undertake it. They have accordingly commenced operations, and it is hoped that the copy may be produced ready for the press in about five years. Owing to the enormous increase in the number of scientific publications at the close of the last century, it is estimated that to complete the Catalogue and to subsidise a publisher for undertaking the printing and publication, he retaining the proceeds of the sale, will cost at least 12,000*l.*

The question now arises whether the funds of the Royal Society ought to continue to be burdened with any part of this expense. The activity and responsibilities of the Society have greatly increased in recent years, and it is much straitened by its inability to increase its expenditure, either on its own establishment or in other directions, owing to the incessant demands of the Catalogue. The Council consider that the time has now come for them to appeal to those who are in a position to afford substantial financial assistance, to enable them to complete this great undertaking without devoting any part of their funds, so sorely needed for other purposes, to this object. They are thankful to be able to announce that Dr. Ludwig Mond, F.R.S., has been so impressed with the importance of the Catalogue, with the necessity for producing the subject index of the scientific literature of the past century so far as possible in the same complete form as that adopted by the International Council for the literature of the present century, and with the justice of the view that the Royal Society ought for the future to be relieved of the cost of producing the Catalogue, that he has most generously added to his previous gift of 2000*l.* the munificent donation of 6000*l.*, payable in four annual instalments of 1500*l.*

The President and Council have also much pleasure in stating that Mr. Andrew Carnegie, fully appreciating the value of the Society's undertaking and the claims that it has on the liberality of those who, though not Fellows of the Society, are interested in the promotion of natural knowledge, has contributed the handsome sum of 1000*l.* towards its accomplishment. They venture to hope that others may be willing to contribute towards a fund to provide for the total cost of this national work.

November, 1902.

THE BERLIN TUBERCULOSIS CONGRESS.

THE Congress on Tuberculosis, which has recently concluded its sittings in Berlin, was instituted under the auspices of the Central International Organisation for the Prevention of Consumption, which is itself an outcome of the international congresses which have met during recent years in Paris, Berlin, Naples and London. An international association of this kind is to some extent a new departure and is not without political significance; its analogue may be found in the international systems at present existing for meteorological observations. Heretofore international cooperation against disease has been confined to sudden outbreaks of the more virulent epidemic maladies. It must be the sincere hope of every philanthropist that the result of this organisation may be the complete annihilation of one of the most potent and widespread causes of disease in existence.

The dissemination of tuberculosis was naturally one of the subjects which engaged the attention of the Congress. It is now recognised that tuberculosis is an infectious disease, and therefore that it is preventable. One of the chief sources of infection is the sputa of consumptive patients. In this connection much has been done recently to check the habit of indiscriminate spitting in public places. At the present time in Glasgow, Manchester, Liverpool and some other towns, it is a penal offence to spit on the corporation tramcars, and the Glamorganshire County Council has made a bye-law to the effect that spitting on the floor of public carriages, churches or other public buildings is punishable by a fine not exceeding 5*l.*

Another point of interest brought to light by the Congress was the growth during recent years of provision for consumptive patients in sanatoria. This has occurred through new hospitals being built and old ones being enlarged. As a marked instance of the latter, the Mount Vernon Hospital at Hampstead may be quoted. Four years ago there was accommodation at this hospital for fifty patients; when the present building operations are complete there will be accommodation for two hundred and fifty. At the present time in the United Kingdom there are, however, only about 1000 beds for poor patients and about 1200 for paying patients.

The question of the compulsory notification of tuberculosis and the disinfection by the municipal authorities after deaths from tubercular disease was also discussed. The opinion seemed generally in favour of compulsory notification, which already exists in Norway. An interesting paper was read on the subject of dispensaries for consumptives, which have been founded in Belgium. They are supported by private societies with the aid of town councils. The patients receive food, coal, clothes, bedding, antiseptics, lodging disinfection every three months, and family washing every week.

Perhaps the most interesting item in the proceedings of the Congress was Prof. Koch's address upon the transmission of bovine tuberculosis to man. This authority maintains the thesis he enunciated in London last year, that the meat and milk of tuberculous cattle are very rarely, if ever, the sources of tuberculous infection to the human subject. In this connection Prof. Koch laid special emphasis on the fact that though for more than a year past he had received official reports of all tuberculous cases coming under the notice of the German hospitals and the professors of pathology at German universities, no undoubted case of primary tuberculous infection of the intestines had occurred. He also drew attention to the fact that most drastic measures would be required if the meat and milk of tuberculous cattle were condemned as food, and that such an action would cause a great increase in the price of these foods, which would be to the detriment of the community.

F. W. T.

ANTHROPOLOGY AND GOVERNMENT IN THE UGANDA PROTECTORATE.[1]

IF the population of British East Africa, or even of the Uganda Protectorate only, can furnish as many anthropological problems as that of the little corner of the country between the north-eastern horn of Lake Victoria Nyanza and Mount Elgon, it is quite time that a scientific collection of the facts were commenced. Mr. Hobley's "Ethnological Survey" deals only with a district about 120 miles long by 60 or 70 miles wide. He enumerates within this area four distinct races, or at least peoples of four stocks, beside a number of miscellaneous tribes whose racial connections are at present unknown. It is obvious that with such a wealth of material a work of 95 imperial octavo pages must simply be of a preliminary character.

The only stocks with which the author attempts to deal in detail are the Bantu Kavirondo, interesting as being "practically the most northerly representatives of the Bantu race," the Ja-luo, a Nilotic people, and the Nandi and allied tribes, conjectured to be a mixture of

[1] "Eastern Uganda: an Ethnological Survey." By C. W. Hobley, Assoc. M.Inst.C.E., Sub-commissioner Uganda Protectorate. Occasional Papers, No. 1. (Published by the Anthropological Institute of Great Britain and Ireland, 1902.) Price 10*s.*

Negroes of the Nile Valley and some Hamitic people. The information furnished was collected in the first instance for administrative purposes. It consequently relates chiefly to such matters as would come more directly under the notice of a British official in the early stages of the settlement of the country. Mr. Hobley has in regard to such matters been minute and careful in his inquiries. He has made an excellent beginning, though, as he himself says, "it would be presumptuous to suppose that [his] observations do more than touch the fringe of inquiry into the habits and customs of these interesting people." As examples of the painstaking manner in which he has collected his material, his plans of the Kavirondo and Nandi huts, and his figures, placed side by side, of the hoe (the principal agricultural implement of the continent) used by the Kavirondo and that used by the Nandi, may be referred to. By the courtesy of the Anthropological Institute we are enabled to reproduce these.

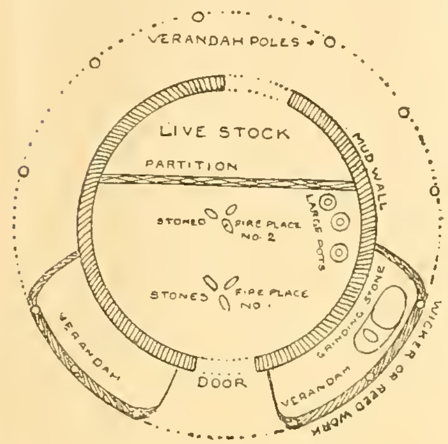


Fig. 1.—Plan of Kavirondo Hut.

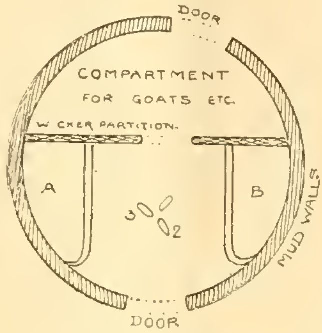


Fig. 2.—Plan of Nandi Hut.

The externals of native life and the outline of their customs, especially the customs relating to marriage and married life, are most fully treated. But there is evidently much detail still to be ascertained, and the underlying beliefs call for inquiry. The social organisation is hardly touched. Mr. Hobley's use of the words *clan* and *tribe* lacks precision. Both words seem to be used territorially; the clan is a local subdivision of the tribe, under a subordinate chief. By anthropologists the word *clan* is now generally used to indicate blood-relationship, actual or imputed. It should be kept strictly for this purpose and some other word found for a village settlement or other local subdivision the inhabitants of which may or may not be held to be blood-brothers. The important subject of religion, so intimately connected with social organisation, is almost a blank. The details concerning divination by the entrails of animals slain (in sacrifice?) and concerning the ceremonies in making peace, however, are interesting and valuable. These are matters likely to have come frequently under the sub-commissioner's eye. On the other hand, he is not likely to have suffered much from the medical practice of the Kavirondo. Hence his account of it is not very illuminating. The anthropologist who reads that the old women who are called in "put pebbles in a gourd and rattle them, and then advise certain remedies," will suspect that the pebbles are not only put into the gourd, but thrown out like dice, and that the practitioner divines from their fall, as among the more southerly Bantu, what is the matter and what remedies, if any, are to be prescribed. Probably Mr. Hobley has never witnessed the ceremony but writes from imperfect information. Useful plates of the Ja-luo are provided, and a plate of three Masai warriors. But nothing in the way of physical measurement has been attempted. Physical descriptions are vague, and evidence of race is chiefly made to rest on the deceptive basis of language. There is an excellent map of the district, showing the distribution of the various tribes. Vocabularies of several of the languages and grammatical observations are appended.

I have called attention to some of the deficiencies of this "Survey," not by any means for the purpose of finding fault, but in the hope that Mr. Hobley, who has commenced so well, will be induced to prosecute the work still further. Such investigations ought to have the most strenuous encouragement on the part of the administration, both for scientific purposes (to which no administration ought to be indifferent) and because everything that contributes to our knowledge of the people, their physical and mental capacities, their prejudices, customs and beliefs must make for good government. E. Sidney Hartland.

NOTES.

Prof. W. H. Holmes, head curator for anthropology of the National Museum, has been appointed chief of the United States Bureau of Ethnology at Washington in succession to the late Major J. W. Powell, the former director. Prof. Holmes is well known to anthropologists for his studies on the pottery and decorative art of the aborigines of America, and on the manufacture of stone implements, &c. He has also decided and advanced views on the arrangement of ethnological museums.

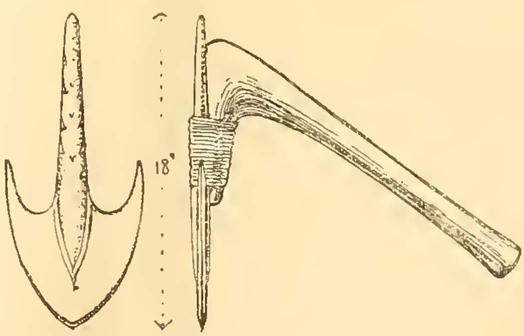


Fig. 3.—Kavirondo Hoe.

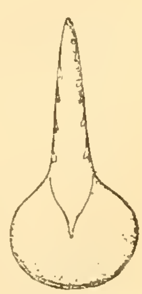


Fig. 4.—Nandi Hoe.

The Lancaster Town Council has decided to confer the honorary freedom of the borough upon Mr. James Mansergh, F.R.S., past president of the Institution of Civil Engineers, who is a native of the borough.

Last week the Bangor Eisteddfod Committee voted from its surplus a sum of 30*l.* to the University College of North Wales to assist in the development of the fisheries department.

In September Prof. White arranged for a fisheries exhibit in the arts and science section of the Eisteddfod, and partly owing to this as well as to the good work which the College has been doing in connection with the Welsh fisheries, the Committee decided to make the grant. The sum will be utilised in developing the fisheries collection at the College, which is in course of formation.

A RICH collection of Babylonian antiquities has been presented by the Sultan to Prof. Hilprecht, head of the archæological department of the University of Pennsylvania, in recognition of the services rendered by him to the Imperial Museum at Constantinople. Prof. Hilprecht has placed the collection in the University Museum.

A TELEGRAM from Kingstown, St. Vincent, published in the *Times*, says:—"The British botanists, Messrs. Powell, Quinton and Foster, spent an hour and a half on the summit of the Soufrière on October 28. The crater was then active, emitting steam and ashes. The new crater showed no signs of recent eruption. There was a slight eruption that night, and the disturbances continue, causing much excitement at Georgetown, where the tremors are continually felt."

MR. JOSEPH CLARK writes from Street, Somerset, to confirm Mr. Clayden's observations of recent remarkable sunsets (p. 659). On Friday, October 24, very brilliant colours were seen and particular notice was taken of the long time during which the clouds to the south-east retained a rosy tint. On Tuesday, October 28, there was a fine display of bright rose-colour on the eastward rolling clouds, an effect also noticed at Paris on the same evening.

WE regret to record the death, on October 23, of Mr. William Gunn, F.G.S. Mr. Gunn joined the staff of the Geological Survey in 1867 as assistant geologist, and attained the rank of district geologist in 1901. He was engaged during his long service in Durham and Northumberland, in the Scottish Highlands and latterly in Arran; and the results of his work appear for the most part in the maps and memoirs of the Geological Survey. His discovery of remnants of Secondary fossiliferous strata in a volcanic vent in Arran was brought before the Geological Society last year. Mr. Gunn had quite recently retired from the public service, having attained the age of sixty-five.

THE Thomson foundation gold medal of the Royal Geographical Society of Australasia, Queensland, will be awarded to the author of the best original paper (provided it be of sufficient merit) on each of the following subjects, the papers to be sent in by the dates named:—(1) The commercial development, expansion and potentialities of Australia—or, briefly put, the commerce of Australia (July 1, 1903); (2) the pastoral industry of Australia, past, present and probable future (July 1, 1904); (3) the geographical distribution of Australian minerals (July 1, 1905); (4) the agricultural industry of Australia (July 1, 1906). The competition is open to members and non-members of the Society alike, whether residing in Australasia or elsewhere.

SOME of the services which medical science has rendered to the State were referred to last week by Lord Roberts in an address delivered at the annual meeting for the distribution of the prizes gained during the past year by the students of the St. George's Hospital Medical School. Lord Roberts remarked that no section of the public was more deeply interested in the work and in the scientific researches of the medical profession than soldiers were, and that a deep debt of gratitude was due to those who, by their constant study, earnest inquiry and careful experiments, learned and taught how to heal the sick, to tend the wounded, to alleviate pain and suffering, to fight sickness and disease and to maintain health in camp and in quarters. A comparison of statistics as to the loss by sickness and disease in the Crimea and during the war in South Africa showed what a changed and improved condition of things prevailed now, changes and improvements which were largely due to the march of medical science. If great results were to be achieved, if success was to be won, there must be no slacking off in any pursuit or profession nowadays, least of all in the professions of medicine and surgery. Fresh fields in many directions remained to be explored, fresh developments to be observed and followed up, fresh results to be recorded.

IT was announced on the reopening of the House of Commons Committee dealing with the London electric railways that the Bill promoted by the London United Railways for a "tube" from Hammersmith to Piccadilly would be withdrawn (see NATURE, vol. lxvi. p. 296). This railway was intended to provide, with the Piccadilly and City and North-East London Railways, a through route from west to north-east, linking the tramway system of the London United Tramways with the City.

THE last link of the Pacific cable was completed at the end of last week, and it is hoped that it will very soon be opened for public traffic. The Pacific Cable Board does not, however, assume responsibility until thirty days after completion. The completion of this cable marks another step forward in cable enterprise. It is more than 8000 miles long, and is built up in five sections as follows:—Vancouver to Fanning Island (3653 miles), thence to Fiji (2181 miles), to Norfolk Island (1019 miles), and then to Moreton Bay, Queensland (906 miles) and New Zealand (513 miles). The cable has been laid by the Telegraph Construction and Maintenance Company at a contract price of rather under 2,000,000*l*., and in less than two years; it is comforting to reflect that England still stands preeminent in this branch of electrical engineering. The completion of the line was made the occasion of the exchange of congratulatory messages between Mr. Chamberlain and the different governors of interested colonies. Among the most interesting of these are two sent by Sir Sandford Fleming to Lord Minto; these completely circled the world, one, in an easterly direction, in 10h. 25m., and the other, going westerly, in thirteen hours and a half. We have still some progress to make before we are able with Puck to "put a girdle round about the earth in forty minutes."

THE presidential address delivered by Mr. J. C. Hawkshaw before the Institution of Civil Engineers on Tuesday covered a wide range of subjects, among them being docks, timber and forestry, canals, means of traffic and transport, the world's supply of fuel, water-power available for industrial uses, and the value of purely scientific studies to the engineer. Upon the latter point, Mr. Hawkshaw made the following remarks at the end of his address:—"Wherever our work may take us we have always something at hand to observe if we give some thought to geology or some branch of biology. Geology calls to its aid all sciences; biology, even botany, is not one, but many sciences. Every science and every question of science is first a matter of fact. Facts observed which seem trivial in themselves may lead to much. Reaumur it was who first suggested that wood-fibre should be used for making paper. He was led to do so from observing the structure of wasps' nests. Out of that observed fact a great industry has grown which threatens to tax the forest supplies of the world. If we accept the view of M. Maurice Levy that from the study of celestial mechanics was derived later general mechanics, then all our progress has come from the study of what was useless at the time it was studied. We might well, I think, increase the number of optional subjects for our examinations. There is no branch of natural knowledge which may not be studied with advantage by an engineer as a change

and relaxation in the round of daily work, and as a training of his power of observation. For after all is said, it is only by observing that we can know."

AT a meeting of the Society of Engineers held on Monday, November 3, a paper was read on "The Effect of Segregation on the Strength of Steel Rails" by Mr. Thomas Andrews, F.R.S. In the course of the paper, the nature and primary causes of segregation in steel rails were described, and the influences of local transverse and longitudinal segregation on the loss of strength in such rails was demonstrated. Microscopic studies have specially indicated some of the latent sources of weakness which occur in segregated steel rails leading to their premature fracture in main-line service. Numerous chemical, physical and high-power microscopic examinations have been made on a considerable number of rails in which local segregation of some of the chemical constituents had been detected, and the author's investigations have demonstrated that local segregation of this nature distinctly reduces the general physical strength and main-line endurance of steel rails in which segregation exists. Reference was also made to the importance, in the interests of public safety, of detecting and eliminating from service, so far as practicable, rails having a tendency to segregated chemical composition.

SIR CHARLES TODD, Government Astronomer of South Australia, has published his valuable report on the rainfall of the colony for the year 1899, showing the monthly and yearly amounts and the averages for previous years at a large number of stations. The report is illustrated by maps showing clearly at a glance the rainfall characteristics of the year. Very few stations registered their average amount, principally owing to the failure of the rains during the latter part of the winter (July and August) and in October and December. The report contains a table showing the yearly rainfall at Adelaide for sixty-one years, 1839 to 1899, and the years when the fall was above or below the normal amount (20·85 inches).

WE have received from Dr. H. Hergesell, president of the International Aëronautical Committee, a preliminary report of the balloon ascents made during the three months April to June last. Austro-Hungary, France, Germany and Russia took part in the investigation, and twenty-one ascents were made. The following were the greatest altitudes attained by the unmanned balloons:—April 3, Itteville (near Paris), 14,260 metres, minimum temperature $-60°·7$ C., temperature at starting 7°. May 1, Berlin, 19,564 m., lowest reading $-58°·5$, on ground 6°·8. June 5, Berlin, 16,750 m., $-58°·2$, 18°·4. Vienna, 10,480 m., $-62°·8$, 15°. The greatest heights attained by manned balloons were in ascents from Berlin:—

April, 5403 m.,	temperature	$-19°·4$,	at starting	6°·6
May, 5510 m.,	,,	$-30°·5$,	,,	6°·2
June, 5936 m.,	,,	$-18°·0$,	,,	20°·9

In the latter case the observers were Dr. Berson, and Prof. Palazzo, of Rome. On each occasion Mr. Rotch sent up kites from his observatory at Blue Hill, near Boston, U.S. On the days of the ascents, areas of low barometric pressure lay over western Europe in April and May, and an area of high barometric pressure in June.

IN his report for the year 1900–1, the first volume of which is now to hand, the chief of the U.S. Weather Bureau directs attention to an important extension of the forecast work of the Bureau made during the year with which the report is concerned. At the end of 1900 was begun, by an arrangement with our own Meteorological Office, the transmission by cable from London to Washington of meteorological reports from certain observing stations in the British Isles and on the continent of Europe, and from Ponta Delgada, Azores. These reports, with observations from Nassau, Bermuda and Turks Island, have been regularly published on the daily weather maps issued at Washington, Baltimore, Philadelphia, New York and Boston, together with forecasts of the force and direction of the wind and the state of the weather for the first three days out of steamers bound east from American ports. Arrangements were also made with Portugal towards the end of 1900 for the receipt at Washington of reports from the meteorological observatory at Horta, in the Azores. Observations are now regularly transmitted by cable from this place, and have proved of much value in the work of forecasting the movements of storms on the Atlantic Ocean.

THE Imperial Department of Agriculture for the West Indies has issued a Report on certain economic experiments conducted in connection with the Antigua Botanic Station during the period from May, 1901, to April, 1902. Considerable variation was shown in the crop results, to a great extent attributable to the abnormally wet season, the year's rainfall amounting to 75·46 in., the total for the preceding year being 42·67 in. February was the only dry month. The experiments have for their objects the improvement of local food products, the introduction of new crops, and the placing on record of interesting facts bearing on insect and fungoid attacks, climatic conditions, &c. An investigation of the black-spot disease of pine-apples and of their rotting during transit to Europe has led to the conclusion that the former is due to injury, during the period of growth, from the attacks of a Penicillium, and the latter to injury, after cutting, from the attacks of *Trichosphaeria Sacchari* (rind fungus) and a species of Diplodia.

PROF. J. SCHNEIDER contributes an interesting paper, on the diurnal movements of the atmosphere at Hamburg, to the September number of the *Meteorologische Zeitschrift*. The wind observations published in the "Deutsche Meteorologische Jahrbuch" for the years 1887 to 1896 are dealt with by resolving into components in west-east and south-north directions, and the diagram of hourly movement shows that the daily curve is entirely closed, its form being egg-shaped, with the narrow end pointing north-east, and its total perimeter about 45 kilometres.

DR. A. SPRUNG describes a number of photographs of halos and parhelia, taken by him at Potsdam on March 23, in the August issue of the *Meteorologische Zeitschrift*. One of the photographs is reproduced. The phenomena are of special interest from the fact that they include both parhelia and the rare large halo, and that the dark spaces are indicated in the photographs. Measurements of the plates give the following mean results, which are compared with the means of direct measurements made by different observers:—

	Mean radius of small ring.	Distance of parhelia.	Mean radius of large ring.
Photograph ...	22° 22′	23° 2′	46° 25′
Observers ...	22° 23′	24° 24′	46° 15′

THE problem of the representation by a finite number of parametric formulæ in two variables of the neighbourhood of a singular point of an algebraic surface was first solved in 1892 by Gustav Kobb, but his solution received criticism at the hands of Beppo Levi in 1897. Mr. C. W. M. Black, writing in the *Proceedings* of the American Academy of Arts and Sciences, now gives a new investigation of the problem, which is claimed not only to supply the deficiencies in Kobb's reasoning, but also to extend the discussion from the case of an algebraic surface to the more general case of any analytic surface whatever.

MR. C. H. HINTON has published, in the *Bulletin* of the Philosophical Society of Washington, a paper on the "Recognition of the Fourth Dimension." In it the author examines

what would be the general character of the motions of bodies in space of four dimensions. The most interesting feature of this line of inquiry is the possibility which is pointed out of constructing representations of the phenomena of electromagnetism by means of vortex motions in four-dimensional space. Thus a vortex with a surface as its axis affords a geometric image of a closed circuit, and there are rotations which by their polarity afford a possible definition of static electricity. Has it occurred to the author that the property that electricity which is free to move in a conductor assumes a superficial distribution may enable us to form a conception of matter in four-dimensional space assuming a three-dimensional distribution?

THE work done by Prof. Barrett and Messrs. W. Brown and R. Hadfield on the properties of alloys of iron is of very high importance to all engineers, whether electrical or civil. The third part of a paper on the subject is published in the *Scientific Transactions* of the Royal Dublin Society for September; the two first parts were published in 1899. In the present section, non-magnetic alloys of iron and alloys more magnetic than best Swedish charcoal iron are considered. Manganese added to iron to the extent of about 13 per cent. gives an alloy which is practically non-magnetic; a still more remarkable effect is seen with manganese-nickel-steels; magnetic alloys of iron with manganese or nickel can be made non-magnetic by adding a suitable amount of the other metal. There is possibly a great future for such alloys in shipbuilding. The alloys more magnetic than the best commercial iron are made with nickel, silicon and aluminium. The authors suggest that an iron alloy containing silicon and aluminium will very probably prove to be the best material to use for transformers. The great value of this work is obvious, and we should like to be able to deal with it more fully; fortunately, the results are easily accessible, as a paper covering practically the same ground as all three of the Dublin papers was read by the authors before the Institution of Electrical Engineers last February (*Journal* I.E.E., vol. xxxi. p. 674).

THE Health Department of the City of London has had a number of samples of ice-creams bacteriologically examined. A large proportion of the samples was found to be unsatisfactory; in several micro-organisms were very numerous, while in some virulent organisms of the *Bacillus coli* type were present; one contained pyogenic organisms and produced abscesses in guinea-pigs, and another contained an anaërobic organism, perhaps the bacillus of malignant œdema. Many of the ice-creams from which samples were examined had set up gastro-enteritis in boys employed by the Post Office. The London County Council (General Powers) Act, 1902, which came into force on November 1, contains clauses relating to ice-creams, regulating their manufacture, &c., and notices in Italian have been printed for distribution among the vendors.

WITH the publication of the October number (vol. ii. No. 4), the *Journal of Hygiene* completes its second volume and its second year of issue. Messrs. Wright and Windsor contribute a paper upon the bactericidal effect of human blood *in vitro*, and find that whereas human blood-serum has a powerful bactericidal action upon the typhoid bacillus and cholera vibrio, it is without action upon the *M. pyogenes*, *B. pestis* and *M. melitensis*. Dr. Haldane details the results of a lengthy experimental investigation upon the air of factories and workshops, Prof. Tunnicliffe discusses the digestibility of the various albuminous constituents of human milk and its substitutes, and Dr. Ritchie concludes his survey of the current theories regarding immunity.

PIOUSLY minded people have a tendency to accept as ancient anything which pretends to be a monument of Biblical history; as a consequence of this trait, Jewish shekels and half-shekels have been forged and even invented to supply the demand. An interesting exposure of these frauds is given by Mr. G. F. Hill in the *Reliquary and Illustrated Archaeologist* for October. There are other illustrated papers in this journal dealing with ecclesiastical architecture and stone-carving.

APART from the superstition bound up with the use of native medicinal remedies of the North American Indians, it is probable that their knowledge of herbs is much more extensive than that of the white man. Mr. V. K. Cheshunt, who has endeavoured to elicit from the Indians of Mendocino County, California, trustworthy information respecting the uses to which they put various indigenous plants, attributes our knowledge of *Cascara sagrada* to these tribes and suggests that other plants, such as Ceanothus, Croton and Eriogonum, would well repay investigation. The diet of the inland tribes is peculiar, as they regard young clover shoots as a delicacy, and make use of acorns and the variety of horsechestnut known as "buckeye" for making a porridge or baking into bread. The method adopted is to pound up the seeds into very fine flour and wash out the tannin and other stringent ingredients with water. A porridge or thick soup is formed by boiling the flour, while a favourite recipe for making bread consists in mixing the dough with red clay. The product is a heavy, black, cheese-like substance, in which the clay probably absorbs the oil and converts the last trace of tannin into a more digestible form. Another curious custom previously in vogue was the use of poisonous plants, soap root and turkey mullein, which were thrown into streams to poison the fish. These were then caught and eaten without any deleterious consequences.

NEW fields for research are continually opening up; the last illustration of this is the discovery by Prof. G. Elliot Smith that it is possible to map the convolutions of the brains of non-mummified ancient Egyptians. The brain is naturally preserved in the vast majority of the bodies in Egyptian cemeteries from predynastic to recent Coptic, the favourable conditions being burial in dry soil and removal from all direct access to the air. Prof. Elliot Smith gives an illustrated preliminary paper on the natural preservation of the brain in the ancient Egyptians in the *Journal of Anatomy and Physiology* (vol. xxxvi. p. 375). In a memoir, which will be published in a short time, he intends to give a full account of the structure of the brain in the predynastic and protodynastic Egyptians.

IN the Report of the Madras Museum for 1901–1902, the appointment of the director, Mr. E. Thurston, as superintendent of the Ethnographic Survey of Madras is an announcement which will be read with satisfaction by all anthropologists. The papers on the hill and other primitive Madras tribes already published by Mr. Thurston have placed him in the first rank among the students of anthropology and ethnography, and he will now doubtless have fuller opportunities of pursuing these subjects. Anthropological studies have, it appears, an amusing, if not a somewhat embarrassing, aspect in Madras. When on tour in one district, for example, Mr. Thurston was reputed to be collecting for the Victoria Memorial, inoculating for the plague and recruiting for the Boer war, the measurements that he took giving rise to the idea that he was an army tailor! The ethnographic reports of native assistants are, moreover, not exactly what they should be, as witness the following:—"They know how to make fire; *i.e.*, by friction of wood as well as stone, &c. They take a triangular cut of stone and one flat oblong size flat. They hit one another with the maintenance of coir or copper, then fire sets immediately and also by rubbing the two barks frequently with each other they make fire."

THE account of the "Plants of Chatham Island," which formed the subject of an address by Mr. L. Cockayne to the

members of the New Zealand Institute, not only possesses the interest which attaches to the impressions obtained by a personal visit, but is additionally so as it is still possible to trace the original vegetation and study the changes which are taking place owing to the introduction of animals and foreign plants. A remarkable and regrettable instance of the latter is the almost complete annihilation of the plant well named *Myosotidium nobile*, which originally lined the shore just above high-water mark. The sheep feed on the leaves and the pigs grub up the rhizomes, and now this plant is limited to quite a few localities. A striking feature of the island is the large Te Whanga lagoon, which occupies about one-third of the island. This, however, is not so important botanically as the swamps, which represent a transition stage from lagoon or lake to drier localities which rapidly become forest lands. Not the least curious feature, and one which has been noted but not satisfactorily explained in other countries, is the occurrence of plants with xerophytic characters growing in the swamps. Such an one is a peculiar Restiaceous plant, *Leptocarpus simplex*, which grows in the wettest parts, while another is *Olearia traversii*, which, however, may be taken as an indication that the swamp is passing into a dry condition.

Messrs. James Swift and Son have sent to us, for trial, one of their compound microscopes of recent type, fitted with their newly patented "Ariston" fine-adjustment. The essence of this is the setting of the micrometer-screw and its milled head upon a closed tube, which, like a jacket, surrounds the pillar. By the attachment to the head of this jacket of a couple of levers, upon the upper part of which the screw reacts by means of a fine point, there is assured a successful elimination of the troublesome side-movement resulting from a bending of the metal composing the limb when the fine-adjustment is subjected to pressure. In thus ensuring to the operator the comfort of absolute rigidity, the conditions employed give with a coarse screw a slow rate of speed and a very delicate result. The apparatus is entirely satisfactory, and can be fitted to certain of Messrs. Swift's microscopes at small cost. It is worthy their newer mechanical stage, their ruled "finder," and the devices, simple but effectual, which they have from time to time introduced into the construction of their instruments for compensation in wear and tear. In these and other similar matters of recent years, Messrs. Swift have shown themselves constantly on the alert for improvement. In the excellence of their $\frac{1}{12}$-in. homogeneous oil immersion, they have produced an English-made lens of first-rate capacity which is a marvel of cheapness; and it must not be forgotten that in the early days of the modern student's microscope they were the first to introduce the Jackson type of stand, just as we believe it was the Englishman Collins who similarly first produced the iris-diaphragm, which, like it, was a triumph for British manufacture.

The Report of the U.S. National Museum, under the direction of the Smithsonian Institution, for the year ending June 30, 1900, is, as usual, remarkable for the many interesting papers it contains and the wealth of beautifully executed illustrations which accompany them. The first part of the volume contains the report of the assistant secretary, and includes sections contributed by the head curators of the departments of anthropology, biology and geology. Part ii. makes up nearly 600 of the 738 pages to which the report runs; it contains seven contributions, some of which may fairly be called monographs. Mr. W. H. Holmes, head of the anthropological department of the museum, describes his anthropological studies in California, his contribution being illustrated with fifty excellent plates. The pictures of the baskets made by the Tulare Indians and the scenes showing incidents in their everyday life are particularly fine. An exhaustive study of aboriginal American harpoons, in which they are treated as a study in ethnic distribution and invention, is by Dr. O. T. Mason, the curator of the division of ethnology. Nineteen plates and nearly a hundred figures accompany this article. The Commissioner of the Imperial Maritime Customs Service of China, Mr. A. E. Hippisley, gives a sketch of the history, with twenty-one plates, of ceramic art in China, and supplies a catalogue of the Hippisley collection of Chinese porcelains. The remaining papers are, "Contributions to the History of Musical Scales," by Mr. C. K. Wead, of the U.S. Patent Office; "A Collection of Hopi Ceremonial Pigments," by Mr. W. Hough; a "Descriptive Catalogue of the Collections of Gems in the U.S. National Museum," by Mr. Wirt Tassin; and a catalogue of the meteorite collection, by the same author.

Messrs. C. Griffin and Co., Ltd., have recently published a ninth edition, revised and enlarged, of Prof. A. Jamieson's "Elementary Manual on Steam and the Steam Engine." From the same publishers we have received the fifth edition of Prof. Jamieson's "Elementary Manual of Applied Mechanics," which has also been enlarged.

A number of stereoscopic slides of scientific interest have been prepared by Messrs. Erdmann and Schanz, Bedford Hill, Balham, London, S.W. Among the subjects represented are type studies from India and Ceylon, hoar-frost scenes and wild animals. A compact and effective stereoscope with aluminium hood is supplied by the same firm.

Two more volumes belonging to the *Scientia* series, published in Paris by M. C. Naud, have been issued. One, No. 14 of the biological series, by Prof. A. Imbert, of the University of Montpellier, is entitled "Mode de Fonctionnement économique de l'Organisme." The other, No. 20 of the physico-mathematical series, is by M. H. Laurent, "Sur les principes fondamentaux de la Théorie des Nombres et de la Géometrie." Each volume is a short monograph giving the present state of knowledge of the subject surveyed.

The thirty-fourth volume of the *Proceedings* of the London Mathematical Society, which has now been published, contains the papers communicated to, or read before, the Society from March, 1901, to April, 1902, and some of the contributions included in the publication are of high mathematical interest. We have also received the second volume of "Mathematical Questions and Solutions from the *Educational Times*." The collection is edited by Miss Constance Marks, and is supplemented by papers and solutions which have not hitherto been published.

The volume containing the physical papers of the late Prof. Henry A. Rowland, the preparation of which for publication was announced in April of this year, is now nearly ready for distribution to its subscribers. It has been edited under the direction of a committee, consisting of President Remsen, Prof. Welch and Prof. Ames, who have made every effort to present to the world, in a suitable form, this memorial of their colleague. The price of the volume will be one guinea per copy for orders sent in advance of publication, after which the price will be increased. Orders may be sent to Prof. Joseph S. Ames, Johns Hopkins University, Baltimore, Maryland.

A brilliant address on "The Rise of the Experimental Method in Oxford" was delivered by Prof. Clifford Allbutt before the Oxford University Scientific Club last May, as the ninth Robert Boyle lecture. An abstract of the address was given in these columns on May 22 (p. 90), and readers of it could not fail to be struck by the richness and charm of the style in which Prof. Allbutt dealt with his subject. The complete discourse, which has now been published by Mr.

Henry Frowde at the price of one shilling net, should be obtained by everyone interested in the history of science.

IN a communication published in the May number of the *Transactions* of the American Microscopical Society, Messrs. Whipple and Parker discuss the connection between the amounts of oxygen and carbonic acid dissolved in natural waters and the occurrence in these of microscopic organisms. It has long been known that exhaustion of nitrates takes place in ground water supporting a vigorous growth of algæ, and it has been assumed that nitrates are the fundamental factor in the development of these. Nitrates are indeed important, but the inadequacy of this explanation became manifest when it was observed that some water, comparatively poor in nitrates, at times supported large growths of algæ. The authors point out the apparent importance of carbonic acid, and express the opinion that the algæ are influenced by it more than by the nitrates. The study of the number of organisms in water at different depths has given some interesting results. Water taken from Lake Cochituate was found to contain the following numbers of Mallomonas per cubic centimetre :—

Depth in feet ...	0	10	30	30	40	50
No. of organisms	0	0	1454	548	112	88

At the surface and throughout the circulating water above the thermocline, oxygen was abundant, but carbonic acid was absent. Near the bottom of the lake there was carbonic acid, but no oxygen, whereas just below the thermocline both gases were present, and as Mallomonas is a chlorophyll-bearing organism it found there conditions favourable for its development.

THE additions to the Zoological Society's Gardens during the past week include two Kusimanses (*Crossarchus obscurus*), a White-crested Tiger Bittern (*Tigrisoma leucolophum*), a Great-billed Touracou (*Turacus macrorhynchus*), a Sharpe's Wood Owl (*Syrnium nuchale*) from West Africa, presented by Mrs. Hurst; a Mute Swan (*Cygnus olor*), a White-fronted Goose (*Anser albifrons*), four Widgeon (*Mareca penelope*), two Pintails (*Dafila acuta*), four Pochards (*Fuligula ferina*), six Common Ducks (*Anas boscas*) European, two Black Swans (*Cygnus atratus*) from Australia, presented by Mr. W. N. McMillan; a Persian Gazelle (*Gazella subgutturosa*) from Central Asia, presented by Mr. B. T. Ffinch; two Emperor Boas (*Boa imperator*) from Central America, presented by Dr. Hans Gadow, F.R.S.; a Thick-tailed Opossum (*Didelphys crassicaudatus*) from La Plata, a Blue-fronted Amazon (*Chrysotis oestiva*) from South America, deposited.

OUR ASTRONOMICAL COLUMN.

VARIATION IN MAGNITUDE OF α ORIONIS.—Mr. D. E. Packer, of Birmingham, has recorded, in a letter to No. 1961 of the *English Mechanic*, the observation that α Orionis is increasing in brightness. Although a known variable, its general variations for the past thirty years have been so minute as to attract no particular attention, but Mr. Packer says that, on the night of October 15, the star was distinctly brighter than Capella and only slightly less bright than Sirius.

Herschel recorded very marked variations in the magnitude of this star between 1836 and 1840, and Sir W. Huggins noticed variations in its spectrum during a second period of variability, 1849–1852. Mr. J. E. Gore confirms Mr. Packer's observations.

THE NEBULA AROUND NOVA PERSEI.—Prof. C. D. Perrine publishes, in the *Bulletin* (23) of the Lick Observatory, several reproductions, and the measures, of the excellent photographs of the nebula around Nova Persei which were obtained with the Crossley reflector, and he also discusses the striking changes observed in the condensations of the nebula.

From measurements of the negatives obtained on March 29, 1901, and January 10–11, 1902, respectively, it appears that the inner ring of nebulosity is expanding radially, at an average rate of 1″·4 per day, whilst the outer ring is similarly expanding 2″·8 per day. These measurements of the inner ring would carry it back to the Nova on February 8, 1901, whilst the outer ring is similarly carried back on February 16–17; both the plates give the same dates. This does not imply the prior formation of the inner ring, for, considering the uncertainties of measurement, Perrine suggests their contemporary origin.

Many suggestions have been made to explain the apparent velocities of parts of the nebula, the two chief explanations being the transition of material particles, and the propagation of a wave of light through, and reflection from, the fine particles of matter making up the nebula. The former seems unlikely, because the movement contains a large tangential factor, whilst the latter theory would have to presume largely variant velocities of the light waves, a presumption which is inconsistent with our present knowledge of light. In order to test the "reflection" theory, Prof. Perrine introduced a double-image prism between the plane mirror of the Crossley reflector and the photographic film, and found that the light was not polarised, *i.e.* the two images were of equal intensity. On polarising the light from α Lyræ and treating it in the same manner, he found that the mirrors of the instrument had practically no effect on polarised light.

The final result points to the existence of little or no polarisation in the light from condensation D, and, with less certainty, in that from condensation A, and therefore refutes the reflection theory.

CORONAL DISTURBANCE AND SUN-SPOTS.—In No. 98 of *Popular Astronomy*, Prof. Perrine demonstrates the close connection between the coronal disturbance, photographed at Sumatra during the total eclipse of 1901, and the group of sun-spots and extensive faculæ which came round the limb of the sun on May 19.

From photographs of the solar disc obtained at Dehra-Dun, India, between May 18 and 28, inclusive—of which copies were kindly supplied to Prof. Perrine by the Astronomer Royal—it is seen that a fairly large group of spots and faculæ came round the limb on May 19, and that at the time of the eclipse this group would be very near to the limb. The position angle of the spot, as projected on to the limb, was 60°·2, whilst that of the apex of the coronal disturbance was 60°·0, and during the eleven days under observation this was the only group of spots photographed. This shows conclusively that the spot and the coronal disturbance were in the same line of sight, and further reductions have shown the probability that the origin of the coronal disturbance was also near to the limb at the time. The long, thread-like prominence seen projected almost tangentially from the sun's limb during the eclipse appears to have emanated from the same group of spots and faculæ, so that, in this case at least, all these phenomena appear to have had a common origin.

This aggregation of related phenomena seemed to point to the possibility of the existence of a great disturbance in the solar atmosphere on this date, and a further investigation was made in order to discover if any measurable displacement of the coronal masses took place in the disturbed region. The photographs compared were taken at an interval of five minutes, and no measurable displacement can, with certainty, be traced thereon; from this we may conclude that the velocity across the line of sight was less than twenty miles per second. A comparison between the photographs obtained at Mauritius and Sumatra, respectively, with an interval of one-and-a-half hours, would probably decide this question of movement.

THE VARIABLE STAR 13, 1902, LYRÆ.—Further observations of this Algol variable have given the following results :—

Approximate position for 1900, 19h. 12m. 31s. +32° 14′·8. Range of magnitudes, 10·98 to about 12·8. Period, 3d. 14h. 22m. 23s.·5.

The Variable Star Committee of the Astronomische Gesellschaft has assigned to this star the designation R.V. Lyræ (*Astronomische Nachrichten*, No. 3821).

NEW VARIABLE STAR, 15, 1902, DELPHINI.—Dr. Anderson, of Edinburgh, has communicated to No. 3821 of the *Astronomische Nachrichten* his observation that a star, not mentioned in the B.D., but having the approximate position R.A. = 20h. 34m. 43s., Dec. = + 11° 21′·5 (1855·0), has proved to be a variable.

Assigning the magnitudes 9·5, 9·7 and 11·2 to B.D. + 11°·4353, B.D. + 11°·4358, and a star having the approximate position

20h. 34m. 37s. + 11° 18'·5, respectively, the following magnitudes have been observed for the newly discovered variable :—

Date, 1902.		Magnitude.
September	4	9·6
,,	6	9·6
,,	24	9·8
,,	25	9·8
October	7	10·2

EDUCATION AT THE BRITISH ASSOCIATION.

THOUGH the youngest offspring of the British Association, the Section of Educational Science has developed so rapidly that its growth in strength and influence is being watched with interest not unmixed with anxiety by several of the older sections. Most of the meetings devoted to the discussion of educational topics were largely attended this year, and all of them have been reported in detail, thus showing that science in education and education in science appeal to a wide public. The Section provides a platform on which it is possible, not only to state the place science should occupy in the curricula of school and college, but also to describe the character of the instruction which should be given, and to construct an organic educational science out of the disjointed body of opinion. It is easy to see that, rightly directed, the work of the Section may have an important influence in determining lines of progress in education ; and the success so far achieved justifies faith in the promise of the future.

One characteristic of the proceedings of the Section is especially noteworthy. Instead of accepting a variety of papers on diverse disconnected subjects, each meeting has been devoted to the discussion of a specific matter introduced by one or two papers. Attention has thus been concentrated upon definite points, and it has been possible to obtain the expression of competent opinion around them. Imperfections of scope and method have been pointed out, difficulties described and reforms advocated with a breadth of view and maturity of experience which command the attention of the educational world.

As an instance of the effect of the work of the Section, mention may be made of the discussion on the scope and teaching of elementary mathematics, opened last year by Prof. Perry, which led to the appointment of a committee with Prof. Forsyth as chairman. In the report presented by this committee, several desirable reforms were indicated, all of them of a kind capable of adoption by teachers and examiners. The committee considers that different methods of teaching mathematics might be adopted for different classes of students, and corresponding types of examination should be used. Emphasis is laid upon the recommendation that the teaching of demonstrative geometry should be preceded by the teaching of practical and experimental geometry, together with a considerable amount of accurate drawing and measurement. In demonstrative geometry, no single book should be placed in a position of authority, nor should there be a single syllabus in control of all examinations. It is recommended that some association of arithmetic and algebra with geometry is desirable in all cases where this may be found possible. Examining bodies are advised that no candidate should be allowed to pass unless he gives evidence of some power to deal with questions not included in the text-book adopted. With regard to arithmetic and algebra, regret is expressed that the decimal system of weights and measures has not been adopted in this country. Graphical methods should be used wherever possible, and tables of simple functions should be introduced as soon as the student is capable of understanding the general nature of the functions tabulated.

In opening the discussion on points arising from this report, Mr. A. W. Siddons described the recommendations of the Mathematical Association Committee, of which he is honorary secretary. Like the British Association Committee, that of the Mathematical Association recommends that a first introduction to geometry, and to each new branch of geometry, should be experimental with the use of instruments and numerical measurements and calculations. So far as deductive geometry is concerned, Mr. Siddons pointed out that there seem to be four alternatives :—(1) To have no one syllabus placed in the position of authority; (2) to replace Euclid by *one* standard syllabus; (3) to modify Euclid by omission and readjustment ; (4) to retain Euclid in its present form.

The Mathematical Association Committee has recommended the adoption of a modified Euclid ; it is considered that the time is not yet ripe for the proposal of a standard to be adopted finally in place of Euclid. The modifications proposed include :—(1) The omission of some propositions which do not help on the course or which should be regarded as axiomatic ; (2) improved methods of proving other propositions, including the use of hypothetical constructions ; (3) the addition of a few propositions ; (4) the adoption of Playfair's axiom and the "limit" definition of a tangent ; (5) the use of angles greater than two right angles ; (6) that the exact treatment of incommensurables be regarded as a branch of higher mathematics.

The discussion upon the two reports was distinguished this year by the fact that mathematical masters from several public and other large schools were present and took part in it. It is evident from the opinions expressed that reforms in the directions advocated by the two committees would be welcomed by many teachers.

Mathematical ideas can be obtained by means of Froebel's boxes of geometrical solids and simple plane figures, but the school work after the kindergarten is not usually conducted on the same sound and systematic plan. An address on the subjects to be taught as science in schools and the order in which they should be taken, given by Dr. C. W. Kimmins, indicated desirable directions of study. Dr. Kimmins pointed out that the great reforms which have taken place in recent years in the teaching of science in schools have been due in large measure to the British Association report on the teaching of chemistry. Similar reports are needed on the teaching of other subjects suitable for instruction in schools, and it is hoped that the committee appointed on the teaching of botany will be of value in this connection.

Dr. Kimmins suggested that the interval between the kindergarten (pupils five to eight years of age) and the experimental science course should be utilised for suitable nature-study teaching. During this interval, thorough instruction should be given in practical mathematics, including the mensuration which is generally taken as part of the experimental science course. This should be given in the time devoted to mathematics, not science. Finally, it was considered that the subjects requiring special attention are the teaching of natural history and botany, and the correlation of science and art teaching.

When experimental science is introduced into schools, the best course of practical instruction to follow is one based upon heuristic principles, such as that which has been introduced into Irish national schools. Mr. W. Mayhowe Heller, who has organised the work, described the methods and results of the scheme. The Commissioners of National Education, in taking steps to introduce practical instruction into their schools, are attempting to do the work accomplished in the towns of England and Scotland by local educational enterprise. In elementary science, the typical course for boys and girls is based on the 1889 recommendation of the British Association Committee. Teachers attending training courses have to perform all experiments of the course themselves. Free equipment grants of apparatus for manual instruction and elementary science are given to necessitous schools. Very few schools at present have laboratories, but at the same time a great deal of individual experimenting can be accomplished. Object lessons are allowed as a substitute for a systematic course of instruction in experimental science, but these must attempt to achieve the same results as the science lesson, viz. accurate habits in observation, work, description and reasoning. Practical instruction of this kind is of the highest importance to Ireland ; for upon its successful introduction into the national schools depends the future of technical instruction.

The position of science in Irish intermediate schools was brought before the Section in two papers, one by Mr. R. M. Jones, head-master of the Royal Academical Institution, and another by Mr. T. P. Gill, secretary of the Department of Agriculture and Technical Instruction. Mr. Jones gave a survey of the working of the new scheme of intermediate education and indicated the probable tendency of developments. Practical work in physics and chemistry has been introduced into intermediate schools, the scheme followed being that of the Department of Agriculture and Technical Instruction. The result is that laboratories in which simple measurements and weighings can be conveniently carried on have been provided in many

schools, and the work done in them is of a most inspiring character both to teacher and pupil.

The science programme for the Irish intermediate or secondary schools was dealt with by Mr. Gill, who though by training and inclination a humanist, expressed his complete satisfaction with the aims and scope of the scheme. The programme was introduced for three reasons, which Mr. Gill expressed,as follows:—

"First, because we believe that science has a part as well as letters in the science of general education—(remember, I am speaking now only of the science part of the programme, and only of the secondary schools)—and, secondly, because the teaching of experimental science according to this programme involves a method now commonly called the heuristic method, which we believe has a great educational value and may be applied to the advantage of the study of other subjects as well as science. The third reason is the special value of science in connection with technical instruction."

Mr. Gill confessed that in admitting the claim of science in general education, and standing as its champion, he did so as a convert, and one who has been brought to that realisation of the power and value of science which is forced upon every modern man. "Scientific physics," he remarked, "which have now their recognised place in public instruction, are admittedly no more difficult to learn or to teach than Latin or Greek, and in our Irish public schools at the present time I venture to say Latin and Greek are not so well taught as our experimental science, with all the great drawbacks and the difficulties which have beset us in the endeavour to provide teaching power. The secondary school which has to do with the future leaders, the industrial and intellectual leaders of the country, would hardly be true to its function as a preserver of the equipoise of general knowledge, would hardly be a living institution informed by the spirit of the age, if it failed to take notice in its curriculum of the place science occupies to-day in the mental and material life of society."

Dr. W. J. M. Starkie, Resident Commissioner of National Education in Ireland, created a sensation among Irish educationists by a paper in which he criticised the recent reforms of primary and secondary education, undertaken with a view to their coordination. He condemned the managerial control of national schools in Ireland, and pleaded for that which every civilised country in Europe has long since attained—a single local authority for education outside of technical schools and universities. Nothing can be done, however, until educated and independent laymen come forward in sufficient numbers to make their influence felt on such authorities.

As regards English schools, Dr. J. H. Gladstone read the report of the committee on the teaching of science subjects in elementary schools; but the changes which have been caused by the introduction of the Block grant in place of the former examination grants have made it difficult to arrive at definite information as to the number of pupils receiving instruction in science. It is felt that the time has now arrived for a general survey of the progress made since the committee was appointed in 1879, and such a statement will, it is hoped, be presented to the Association next year.

Before any subject can be taught with success, the health of the pupil and the training of the teacher have to be considered. A preliminary report of the committee on the conditions of health essential to the carrying on of the work of instruction in schools was presented by Prof. C. S. Sherrington, F.R.S. Attention has so far been directed to the following points:—The periods of day appropriate for different studies, the length of lessons, and periods of study suitable for children of different ages; anthropometrical and physiological observation forms in use in various schools with a view to preparing a typical form for general use; anthropometrical and physiological observations recorded in different schools for a series of years on the same children; investigations into the causes of defective eyesight in school children and a definition of the conditions necessary for preserving the sight; the practical knowledge of hygiene possessed by school teachers. Much interesting information has been collected and tabulated, and it is hoped that when the final report is presented next year some action will be taken upon its recommendation.

Given pupils in a condition to study with profit, it is desirable that the teachers should be trained to direct their mental activities. In a paper on the preliminary training of teachers, with special reference to women, Miss L. E. Walter described the various avenues to qualification as teachers in elementary schools, and suggested some practicable improvements in the courses of study pursued between the ages of about fourteen and eighteen years. She condemned the excessive book-work which must be done by pupil teachers who desire to pass their examinations, especially when scientific subjects are concerned. It was urged that in every pupil teachers' school or centre the students should be taught (1) how to read books with permanent profit; (2) how to increase their knowledge practically by simple experiments as distinct from book-work.

In the course of a brilliant address, Prof. H. L. Withers pointed out that the problem of the training of teachers is essentially different in a primary and secondary school. In the former a considerable, though incomplete, system has been in existence for the best part of a century, while in the latter the provision made is still so defective that at least in the case of boys' schools it may be said that we have everything to do from the beginning. For the primary teacher large Government grants are given, while nothing is as yet allowed for the secondary. Primary schools are fairly homogeneous. Secondary schools display a great multiplicity of types, social and educational, day and boarding. The problem in the two cases was, therefore, treated separately by Prof. Withers. As regards the latter, it was remarked that the multiplicity of types is so great that anything like a single stereotype system of training would be futile. The secondary schools themselves must take a large share in framing an elastic variety of systems, and the training provided must be consistent with all that is best and strongest in our existing tradition. Analogy with other professions suggests that a combination between the great schools and the Universities is essential for the institution of a complete system of professional training. Though in several respects the position of men as regards training is quite distinct from that of women, yet for the purposes of both who desire to obtain their professional training at universities, each university should, for the future, be equipped with a department of education as effective as its departments of law and medicine. As much as possible should be done to refer students to the principles of mental, moral and physical science, upon which the theory and practice of education must ultimately be based.

In secondary schools a knowledge of educational principles is not regarded as of much importance, and young men go to them to teach without having received any training. In the course of time some of them became good schoolmasters, gaining experience at the expense of their pupils. In such cases the school has the same relation to the teacher as the workshop to the engineer, but there is little doubt that the master and the engineer should receive some practical training before undertaking professional duties. Prof. Perry's presidential address on the training of engineers was discussed at a joint meeting with the Section of Engineering. Among the points brought forward in the course of the discussion were, that it would be an advantage if students of engineering could spend five months each year in a workshop and five months in a technical college; that preliminary training in habits of observation and accuracy was of the greatest value; that teachers should be kept in close touch with the practice of their profession, and their laboratories should be equipped with modern tools and machinery; and that we have little to learn from Germany in the matter of education or of turning out work, but much to learn as regards financial ability and the science of commerce.

Language is an important factor in determining commercial developments. It is therefore worth while to consider Sir Frederick Bramwell's suggestion that the great commercial nations—the United States, Germany, France and England—should each adopt a common language to be learnt in addition to their own, in order to facilitate intercommunication and save the trouble of learning several languages for business purposes. Italian was suggested as a suitable language for the purpose, because it is easy of acquirement, founded upon a classic basis, and could be adopted without arousing feelings of jealousy among the nations accepting it. Latin was also suggested as a suitable common language, as it was in mediæval times.

Many people believe that English will in the course of time become the language of commerce, but if this is to be realised more attention must be paid to the teaching of our mother tongue in schools than is usually the case. Mr. P. J. Hartog dealt with this subject in a paper which led to a good discussion. He held that a mastery of our language is as necessary for the so-called practical uses of the leaders in war, diplomacy, science and commerce as for the historian and the philosopher. Though

on the grounds of utility English ought to be given an important place in the school curriculum, it is one of the most neglected subjects. The result is that few boys leaving school are able to write a good letter, and many adults are unable to describe things or events in precise terms. On this account many misleading statements are made which might have been avoided. Mr. Hartog pleaded for the rational and systematic teaching of the mother tongue in our schools. By neglecting this subject the teacher is deprived of a very powerful instrument of education. Prof. G. M. Minchin gave, in a paper, a number of examples of the misuse of common English words and expressions, among them being split infinitives, *without* instead of *unless*, misplaced *shall* and *will*, and many others which should be avoided by all who desire to use words in their correct sense and place, and preserve our language from barbarisms.

Other subjects were considered during the meetings of the Section, but limitations of space will not permit descriptions of them, or of the many valuable points brought forward by speakers in the discussions. It was evident from what was read and said that a large amount of material of interest to men of science and practical teachers is available, so the Section is likely to be even more active in the future than it has been during its two years of existence. R. A. G.

BOTANY AT THE BRITISH ASSOCIATION.

THE semi-popular lecture was given on Monday, September 15, by Prof. F. W. Oliver, on ancient and modern seeds. The lecturer gave a clear and interesting description, illustrated with lantern slides, of the gradual evolution of the seed, and dealt with some of the more interesting questions concerning the morphology of various seed structures.

On Friday, September 12, the botanists paid a visit to the Belfast Botanic Gardens, and under the guidance of the able curator, Mr. McKimm, inspected the extremely interesting fernery which has recently been constructed. On Tuesday afternoon, the Rev. C. H. Waddell, the indefatigable local secretary of Section K, conducted a botanical excursion to Colin Glen. After an interesting ramble, the members were entertained to tea by Mr. and Mrs. Kidd, whose kindness was much appreciated.

Much interest was taken in a collection of characteristic Australian plants, exhibited by Mr. Thomas Steel during the meeting.

Prof. I. Bayley Balfour, F.R.S., exhibited and described specimens of the various forms of *Erica tetralix* found in Connemara. Mr. James Stirling, Government Geologist of Victoria, in a paper on the flora of the Australian Alps, dealt with the origin and distribution of the mixed types of plants now growing on the highest altitudes over south-east Australia, and their correlation with other Alpine and the Tertiary floras of the region.

Mr. R. Lloyd Praeger read a paper on the composition of the flora of the north-east of Ireland. This area includes the counties of Down and Antrim, and the flora numbers 820 species of flowering plants and vascular cryptogams, the total flora of Ireland being reckoned at 1020 species. There is in the local flora an almost complete representation of British type plants. English type plants are rather poorly represented. Scottish type plants reach in Antrim their maximum for Ireland ; in Down they are somewhat fewer. Of Highland type species there is a fair representation ; Antrim, though of less elevation, contains more Alpine plants than Down. Germanic plants are extremely few in Ireland. In Atlantic type plants, Down and Antrim are comparatively rich.

Mr. Herbert Wright (Ceylon) contributed a paper on foliar periodicity in Ceylon, in which he showed that some trees undergo complete defoliation twice per year ; others exhibit incremental foliar activity several times per year, in addition to a complete annual renewal. The irregularity of foliar periodicity is very pronounced. There is not a month when all the trees are in full leaf.

In the department of plant physiology, Prof. J. C. Bose, of Calcutta, gave an interesting demonstration, illustrated by experiments, on the response of plants to stimulation (*vide Journ.* Linn. Soc., xxxv., 1902). Mrs. D. H. Scott gave an account of the movements of the flower-buds and flowers of *Sparmannia africana* up to the time of the setting of the fruit. At first the buds hang all in one plane ; each bud has a joint on the stalk, which is much swollen below the flower. The buds rise one by one from the drooping position to the horizontal ; then make a sharp curve inwards, and just before flowering the bud hangs down in an exactly vertical position. The flowers open during sunlight at a temperature not below 60° F. (15°·5 C.), so that on a cold day perhaps only one flower and on a hot day three or four may be open at the same time. The flowers reopen for several days ; during this time they gradually take up a vertical position, pollen often being formed for five or six days. Then, if fertilised by bees, the flower-stalk falls again into the horizontal position, from which it rises again as the fruit ripens. Mr. Barnard and Prof. Allan Macfadyen, in a paper on luminous bacteria, stated that these organisms require particular and exact conditions in order to exhibit their luminous properties. They must have a suitable nutrient soil containing such proportions of salts as shall render the medium isotonic. A supply of free oxygen is essential ; in the absence of oxygen the organisms live, but are non-luminous. The luminosity appears to be due to the vital processes of the cell, and an exposure to the temperature of liquid air does not destroy it. Prof. Macfadyen and Mr. Rowland also contributed a paper on the suspension of life at low temperatures, in which they showed that ten hours' exposure to the temperature of liquid hydrogen (about − 252° C.) had no appreciable effect on the vitality of the various organisms (bacteria and yeast) tested. Miss Gabrielle L. C. Matthaei (Cambridge) described experiments on the effect of temperature on carbon dioxide assimilation in the leaves of the cherry laurel. The lowest temperature at which assimilation could be detected was − 6° C. This is the first well-established case of assimilation below 0° C. For temperatures between − 6° C. and 33° C. it was found that assimilation is affected in exactly the same way as is respiration. Provided the illumination is sufficient, the assimilation increases with the temperature. Dr. Henry H. Dixon (Dublin) gave an account of some experiments made to determine the resistance of seeds to high temperatures. The maximum temperature to which the various seeds were exposed and still retained their germinating power varied from 90° C. to 121° C. The president communicated a paper by himself and Mr. H. Jackson on the germination of fatty seeds. In the case of Ricinus, the reserves consist mainly of oil and aleurone, hardly a trace of carbohydrate being present. In germination, the oil diminishes and both cane sugar and glucose make their appearance, accompanied by the formation of lecithin, a fatty body which contains nitrogen and phosphorus.

Several important papers on fossil plants were read. Miss Margaret Benson described the seed-like fructification of *Miadesmia membranacea*, Bertrand. The foliage leaf bears a ligule in a longitudinal groove with thickened base and sides. In the sporophylls, the sporangia are inserted singly in the proximal end of the groove, and are large and pedicellate. In the megasporophyll, the sides of the groove are completely coherent above the sporange, and thus form a velum. The wall of the megasporange is composed of several layers of isodiametric cells, and encloses a single thin-walled megaspore or embryo sac. The microsporange has no velum, and the wall is formed of a palisade layer. Miss Benson also described the structure of some sporangia found associated with petioles and other fragments of *Lyginodendron oldhamium*. Mr. Lomax described two specimens obtained from Dulesgate, which show that Lyginodendron had a branching stem ; also that the branch was given off in the one case between two leaf-stalks and in close proximity to several roots. The position of the roots shows that they must have been aërial roots, and not, as generally accepted, basal or confined to the basal regions of the stem. Mr. Lomax also read a paper on the occurrence of nodular concretions (coal balls) in the Lower Coal-measures. These bodies consist of a quantity of fragments of short pieces of stems, &c., some with the cortex, some without, some split in fragments, and so on. From an examination of these nodules it appears that, at least in this case, these plant remains have not grown on the spot where we now find them, and the author comes to the conclusion that the various portions of plants have been carried into their present position after being broken in fragments, and before petrification, or they have been carried from a parent bed after petrification. In a paper on sporangiophores as a clue to affinities among Pteridophyta, Dr. D. H. Scott, F.R.S., pointed out that some years ago he suggested the probability of an homology between the ventral sporangiophores of Sphenophyllum or Cheirostrobus and the similarly placed synangia of

the Psiloteæ; on this ground, among others, an affinity between the fossil and the recent family appeared tenable. This view has recently been supported by Prof. Thomas, of Auckland, N.Z., on evidence drawn from certain remarkable variations which he observed in the genus Tmesipteris. On the view suggested, the synangium of the Psiloteæ is neither a reduced strobilus nor a septate sporangium, but a ventral sporangiophore bearing a variable number of sporangia, normally two or three, according to the genus. Mr. A. C. Seward, F.R.S., and Mr. Arber gave an account of some fossil Nipa seeds from Belgium.

In the domain of plant morphology, several interesting papers were communicated. Mr. John C. Willis, director of the Royal Botanic Gardens, Peradeniya, described the dorsiventrality of the Podostemaceæ, and showed that it extends both to the vegetative and floral organs. The more modified types show a progressive increase in dorsiventrality of the vegetative system followed throughout by an increase in that of the floral. The same series, regarded ecologically, shows that though the flowers are steadily more and more zygomorphic—a condition usually regarded as an adaptation to insect visits—we have here flowers which stand stiffly erect, and are more and more anemophilous and autogamous. Miss Sibille O. Ford (Cambridge) gave an account of the morphology of the Araucarieæ, which include the two genera Araucaria and Agathis; they are characterised by the regularity of their branching and the persistence of their leaves. The apex of the stem shows no definite apical cell, but a somewhat irregular dermatogen. Well-marked annual rings may be found in the wood, and bordered pits are found on the tangential walls of the latest formed summer wood. Mr. Herbert Wright (Ceylon) described the sex relationships in Ceylon species of Diospyros. These plants have hitherto been regarded as diœcious, but he finds from an examination of fresh material frequent departures from this condition, some being monœcious, others diœcious and polygamous, and others diœcious, monœcious and polygamous. Mr. Worsdell gave an account of the various theories as to the nature of the sporangial integuments in various groups of plants. The author maintains Čelakovsky's view that in the ferns the *soriferous segment of pinnule*, bearing as a rule sporangia on its lower (dorsal) surface, is the homologue of the outer integument of the ovule in Angiosperms, and *indusium* that of inner integument. Mr. Worsdell also read a paper on the nature of the vascular system of the stem in certain dicotyledonous orders, in which he comes to the conclusion, from anatomical data, that no hard and fast line exists between the two classes of dicotyledons and monocotyledons. The flowering stem and peduncle, as being those parts of the caulome which have undergone least modification owing to the necessities of adaptation to external conditions, exhibit, as a rule, most clearly the primitive structure which in the vegetative parts has become obscured. Mr E. A. Newell Arber (Cambridge) read a paper on the morphology of the flowers in certain species of Lonicera. The genus includes about seventy species which belong to the section Xylosteum. In this section, the gynœcea of a two-flowered dichasium are more or less completely united together. In some cases, the two inferior ovaries are united in one plane by *the union of their receptacular walls*. In others they are for the most part free from one another, but surrounded by an outer parenchymatous tissue, arising from the base. This tissue is the result of the *fusion of the bracteoles* of the true flowers. Mr. Harold Wager communicated some of the results of his recent observations on the structure of the central body in various species of Cyanophyceæ which show that, although wanting some of the characteristics of the nuclei of higher organisms, it must be regarded as nuclear in character and possibly as a nucleus of a simple or rudimentary type. In another paper, Mr. Wager dealt with the function of the nucleolus. This body, in the cases examined by him, appears to be intimately connected with the nuclear network, and contains chromatin material which contributes directly to the formation of the chromosomes. Prof. Oliver and Miss Edith Chick had a paper on the morphology of *Torreya myristica*, in which some interesting features of morphological importance were described.

Among other papers brought before the Section were the following contributions from mycologists:—Miss Lorrain Smith described a disease of the gooseberry which attacks the hard stem of the bushes above and below the ground level. The inner bark is permeated and completely destroyed by the mycelium of a fungus. The outer bark cracks and splits, and sclerotia are formed on the outside or half embedded in the cortex. Mr. Barker (Cambridge) gave an account of the fungus of Samsu, a fermented drink of Eastern Asia, obtained by the distillation of a fermented liquor prepared from rice. The conversion of the starch into fermentable sugars is due largely to a species of Monascus. Hitherto this genus has been placed in the Hemiasci on account of a supposed formation of spores in a sporangium, surrounded by an investment of hyphæ. It is, however, one of the simplest sexual Ascomycetes. Mr. E. M. Freeman (Cambridge) contributed a paper on the darnel seed fungus, in which several new and important facts were brought forward.

H. W.

CARLSBAD MEETING OF THE GERMAN ASSOCIATION OF NATURALISTS AND PHYSICIANS.

THE seventy-fourth annual meeting of the Association of German Naturalists and Physicians was held on September 21–28 at Carlsbad, after an interval of not less than forty years. At the meeting, very naturally, the hot springs for which the place is famous suggested a suitable subject for discussion. Geologists and chemists alike concentrated their attention upon them. Prof. van 't Hoff, who may be regarded as the veritable creator of modern theoretical and physical chemistry, was there to elucidate the subject. Prof. Meyerhofer applied the latest teaching of that particular science to the springs, exciting a keen interest by his masterly method of dealing with the subject, more particularly when entering into the newest discoveries with regard to the theory of osmotic pressure and of ions which van 't Hoff and Arrhenius have effectively established. The entire organism in biology may be shown to be a collection of osmotic cells, enclosing saline solutions, and the movement of liquids in them is to a high degree, if not entirely, determined by the laws of osmotic pressure.

The Carlsbad springs have been again and again subjected to osmotic analysis, and this has led to a considerably deeper insight into the cause of their hygienic action than the merely chemical analysis which had first been judged sufficient. Mineral waters of high osmotic pressure, so it has been ascertained, remain in the stomach longer than waters of low osmotic pressure, and this fact enables the physician the better to judge what kind of water should be selected in dealing with any particular affection of the stomach. The study of the waters has been carried further, and the value of certain distinct rules and modified methods has been ascertained as facilitating comparison in respect of osmotic pressure between mineral springs and liquids occurring in the human body. Among other results, it has been shown that natural mineral waters are much more efficacious than artificial imitations. Very possibly this is due to the presence in the natural springs of certain chemical substances held in solution in such infinitesimal quantities that make them escape the notice of the purely chemical analyst. Such undiscovered ingredients may very well act by catalytic methods and so increase the efficacy of the solution.

That question, indeed, requires further elucidation, which is likely to prove of much benefit to balneological science, to the relief of suffering humanity.

Another lecture of great interest was that delivered by Prof. Suess, of Vienna, on the nature of hot springs. The mineral springs which are due to infiltration from surface water go by the name of "vadose" springs; they may be either cold or hot, according to their depth. It has been proved in the case of more hot springs than one that they run along earth crevasses formed before their own origin. Thus at Carlsbad the springs have followed the preexisting metallic veins (ore-lodes) which thousands of years ago found an outlet from the interior to the surface. The Carlsbad springs yield yearly about 5·6 million kilogrammes of solid ingredients which originate in the interior of the earth and contain in correspondingly small quantities the same elements as the ore-lodes the course of which they follow. Carlsbad is therefore manifestly a "juvenile," *i.e.* volcanic, water. Attempts made to search for an area of infiltration (as for "vadose" waters) or to estimate the depth of its origin from any kind of a so-called thermal scale have proved absolutely futile. Nor yet can the presence of mineral ingredients be explained by the nature of the granite through which they run to the surface. The cavities which were long supposed to have been formed by the continual effusion of 5·88 million

kilogrammes of fixed ingredients annually are due to an entirely different cause. Carlsbad, it ought to be remembered, stands on a spathic lode of horn stone. Whether its hot waters in the depth still precipitate heavy metals and are active in building up a metallic vein, reaching finally daylight in an impoverished state, or whether the conditions of to-day do not admit of such an activity, it is impossible to say. The presence of arsenic, antimony and zinc, indeed, favours the former conclusion.

The Congress held general meetings in which very interesting communications were made. Thus, Prof. Weber, Amsterdam, had much to say upon the Malay Archipelago and the history of its fauna. He reconstructed, so to speak, the great bridge between the people of East Asia and Australia. Again, Prof. Voller, director of the Electrotechnical Institute of Hamburg, explained the foundation and methods of electrical wave telegraphy. Communications showed that very substantial progress has recently been made, thanks to the theoretical study of the subject by Prof. Braun, of Strassburg, and the practical experiments of Prof. Slaby, of Charlottenburg. Some practical demonstrations of what has been called the Slaby-Braun system, for which the Congress was indebted to the General Electrical Company, of Berlin, and the Society for Wireless Telegraphy (by the Braun and Siemens-Halske process), of Berlin, helped to make the matter very much clearer.

The Carlsbad Congress, which was, according to established usage, held in a number of distinct sections—28 in all—was opened with a very interesting address on the constitution of the molecule of albumen, by Prof. Hofmeister, of Strassburg. Investigation of this important subject is beset by difficulties. However, in spite of this, modern science has, by means of continued inquiry, succeeded in establishing certain valuable facts which promise to lead to a clear knowledge of the subject. Thus it has been ascertained that glycocol, which is derived from albuminoid bodies, becomes transformed into urea. Therefore the road to further discovery must, one would think, lie across glycocol, and we can unconstrainedly trace back the other principal nitrogenous final products, just like urea, to the splitting up of the molecule of albumen, and *vice versâ* we might reconstruct the molecule of albumen from the final products.

Prof. Emil Fischer, of Berlin, in the Section of Chemistry, spoke on practically the same subject in an intensely interesting way. He was able to state that he succeeded in obtaining albuminoid substances by synthesis the possibility of which had so far only been dreamed of.

Furthermore, Prof. Leube, of Würzburg, reviewed the whole question of physiological albuminuria (both "manifest" and "latent"). He showed that in some healthy individuals albumen passes in the urine regularly after standing, whereas it disappears when the persons affected alter their position to sitting or lying. Muscular exertion may also be productive of albuminuria, but only in a standing position. Food of itself causes no albuminuria. It may, indeed, result, after the eating of raw eggs, but only when the person eating them has been standing. Such disposition to albuminuria is probably owing to an innate greater transfusibility of the filtrating membrane of the kidney. It is innocuous. Prof. v. Eiselsberg, of Vienna, dealt with the subject of the thyroid gland. His paper showed that goitre is caused by some mineral constituents occurring in certain geological formations and transmitted by water. In all probability, cretinism is due to similar causes, made effective through the action of the thyroid gland. Prof. v. Wettstein, of Vienna, made "Neo-Lamarckism" his subject, and explained the great importance of "selection" in the development of species, showing that by "selection" alone is it possible to account for the remarkable variety of forms to be observed in the same scale of organisation. The argument is, however, manifestly incomplete. For "selection" cannot account for the progress of development which, on the other hand, "direct accommodation" does explain.

Prof. Penck, of Vienna, in his paper on prehistoric man, proved that the interval between the older and the younger Stone age can only have been a very short one. In future, therefore, we will have to consider rather an advance of the culture of the younger Stone age than an immigration of Neolithic people, bearing in mind that, according to the present standard of our knowledge, Europe is the scene of a prehistoric culture the beginning of which lies a few hundred thousands of years back.

So much for the general meetings. The sectional gatherings proved no less interesting and instructive. In the Pedriatric Section, Dr. Moser, of Vienna, threw new light upon the theory, still to be proved, of the unity of species of the streptococci in scarlet fever. He has used a mixture of bouillon-cultures of streptococci from various cases of scarlet fever for immunising animals. In this way he has obtained a serum from horses which was shown to possess a specific curative value in scarlet fever when tried in the pedriatric clinic of the University (Prof. Escherich). The serum, which was prepared in the Serotherapeutical State Institute (Prof. R. Paltauf), has been used in the clinic since November, 1900. Of 699 scarlet fever cases of St. Anna Hospital, the worst were picked out and 81 received injections. It is the clinical aspect which in all these cases speaks for the specifically curative effect of the serum. If the injection is made on the first or second day there is no death; at a later period the result is less certain. The effect of the injection is that the fever vanishes or subsides, the general feeling improves in a remarkably short time, the nervous disturbances disappear very rapidly, the children feeling surprisingly better. Up to now it has proved necessary to inject the serum in considerable quantities, and the effect has sometimes been that sensitive children have suffered in consequence from eczema. This, however, passes away speedily without causing any injury. In the St. Anna Hospital it was found possible to lessen mortality to 8·9 per cent. out of almost 400 cases, whereas in the other hospitals of the town the average mortality was 13·09 per cent. Yet these results were obtained under partial application of the method, owing to the insufficient quantities and low concentrations only of the serum being available, so that only a fraction of the sick could be subjected to this treatment. Prof. Escherich spoke energetically of the favourable action obtained with the serum. Prof. Paltauf expressed regret that the quantity of serum necessary cannot yet be precisely determined, as is the case with the diphtheria serum. The Government has, however, granted the Serotherapeutical Institute an exceptional subsidy of 10,000 kr. so as to produce this scarlet fever serum in sufficient quantities.

In the Section of Dentistry, Dr. Sickingen furnished really astounding material illustrating the necessity of paying careful attention to the teeth of soldiers. As a result, an appeal was made to the Ministry of War recommending that garrison dentists should be appointed in the army. Furthermore, the Section of Hygiene adopted a resolution urging that as a means of raising the general hygienic condition of the people, special district dentists and school dentists should be appointed by the State and prohibited from engaging in private practice. Dr. Sternberg, in the Section for Pathological Anatomy, related that dead tubercle bacilli may bring about the same anatomical changes as living ones, causing the death of the animals experimented upon. Dr. Kraus, Vienna, spoke of the action of immune-hæmolysine (the serum of rabbits treated previously with canine erythrocytes); small quantities of such serum have been found to produce a grave disease which has been characterised as hæglobinæmia, hæmoglobinuria, grave anæmia or possibly icterus. Prof. Takahasi (Tokio) spoke on poisonous fish. Of such he showed the Tetrotone (called "Tugu" in Japan) to be the most poisonous of all. Its ovary contains most of the poison, the next dangerous being the liver; the muscles, on the other hand, are entirely free from the poison. Accordingly, a police regulation has been enforced, permitting the sale of this fish only after the internal organs have been removed.

Prof. Frick, Zurich, spoke of the treatment of feverish diseases without alcohol, and aroused considerable interest in view of the bearing of this matter upon the anti-alcoholic movement. He said that the popularity of alcohol is entirely due to its quality as a narcotic. Alcohol, however, possesses a number of qualities which make its use seriously contra-indicated in the ward altogether, and more particularly in febrile diseases. Moreover, the power of resistance against infectious matter is abated in the animal organism by the consumption of alcohol, and this is the reason why drinkers show in any kind of infectious disease a lesser power of resistance than people who practise abstinence.

Another question of great interest raised in the proceedings was that of the "circuit of nitrogen." Among the highly instructive communications which were made on the subject, space will permit me here to mention only one. Prof. Meyer, of Göttingen, began his paper with these words:—"Cellulose must become a food stuff." He pointed out the necessity for nitrogen both in vegetable and animal life, and the importance

of preserving it and turning it to practical account in the economy of nature. The population of the German Empire, so he instanced, increases at the rate of one per cent. every year, yet the quantity of nitrogen provided for our sustenance by the ordinary channels remains constantly the same. We shall, therefore, have to take advantage of the free nitrogen present in the air, first to benefit the plants and indirectly to benefit the plant-eating animals. It is known that small organisms, such as the so-called nitrifying bacteria, are able to assimilate directly the free nitrogen occurring in the atmosphere. The immense importance of this economic question is understood upon realising that in the German Empire an area of twelve-and-a-half million acres is covered with lupins and other leguminous plants, cultivated for agricultural purposes, and that these maintain a close touch ("symbiose") with the nitrifying bacteria. The nitrogen of the air which these bacteria attract on such an area may amount to five million quintals, representing at the current market rate something like 300,000,000 marks.

In the Section of Legal Medicine, the director of the Forensic Institute of Graz spoke of the serum diagnostic of blood, and pointed out the difficulties and responsibility involved. Jolles insisted upon the importance of chemical examination of blood, and explained some clinical apparatus which he has devised for such purpose, viz. the ferrometer, the phosphometer and the hæmoprometer.

In the Botanical Section, Prof. Molisch, of Prague, in his paper on the phosphorescence of meat, described the method by which it is possible to obtain such with the certainty of a physical experiment. It is invariably the same micro-organism which causes the phenomenon, namely, the *Micrococcus phosphoreus*, Cohn, a bacterium which has made itself at home all over the continent, though it may be true that it came originally from the sea. Prof. Pribram, Vienna, spoke of the new institute for biological investigation in Vienna, in which it has been made possible to observe an organism during several generations and of studying the principal question of biology, namely, the transmission ofacquired characters. Prof. Roehman, Breslau, showed that he had succeeded in keeping mice in the best of health with food consisting of albuminates, carbohydrates and salts mingled in a certain ratio. Prof. Exner, Vienna, with the help of an "acousto-meter," demonstrated that the bad acoustic properties of many public rooms are due in the main to the existence of an echo. Police-Surgeon Dr. Schrank, in the Section for Hygiene, advocated international legal proceedings to prevent the spreading of venereal diseases.

An important demonstration took place in the Section of Mathematics after Prof. Klein, Göttingen, had finished his report on the present condition of the "Encyclopædia of Mathematical Sciences." Prof. Molk, Nancy, added that this great work is now being edited in common by German and French authors, and that this is the first occasion since 1870 that men of science of either side of the Vosges have been brought into active cooperation. In the Section of Astronomy, Prof. Archenholz, of the Treptow Observatory, mentioned that in the determination of the influence which sun spots have on our atmosphere, it is rather the position of these spots and their size on the solar disc than their number which enters into account. Prof. Hasslinger, of Prague, in the Chemical Section, relates the results of his latest experiments by which he has secured diamonds with Goldschmid's thermite method. By adding carbon in various forms, such as that of finely suspended graphite to a fused mass, similar to the South African mother stone Kimberlit, he succeeded in obtaining true diamonds. This is not only an entirely new method, but also corroborates the theory previously maintained of the natural origin of diamonds.

In the Section of Gynæcology, the conservative treatment by bath cures, mud poultices, hot baths, thermophor, &c., was forcibly advocated as yielding complete success and as well qualified to substitute the radical operations, while pus-formation can be stopped by incision only. Prof. Chroback, of Vienna, pointed out that even so pronounced a radical as Prof. Martine expressed himself in favour of the conservative method. Prof. Kehr, of Halberstadt, gave a *résumé* of no less than 730 operations executed for the removal of gall stones. Where gall stones were removed from the gall bladder, mortality was found to be at the rate of 2 per cent., when the gall bladder was removed with the stones it rose to 3 per cent., and when the stones occurred in the hepatic duct to 6·5 per cent.; however, by continual practice he managed in the last 200 operations to restrict mortality to only $1\frac{1}{2}$ per cent.

From these short notes it will be seen that there was abundant material of a very varied character brought under the notice of the Congress, and dealt with in a manner to make the latter a not unworthy successor of its precursors. Science generally has distinctly gained by its transactions. The next Congress is to be held September 21, 1903. F. SCHUMAN-LECLERCQ.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The 240th meeting of the University Junior Scientific Club was held on October 31. Dr. A. D. Darbishire, Balliol, showed an interesting case of reversion. The offspring of an albino pet mouse and a Japanese "waltzing" mouse bears many resemblances to a common house mouse, and does not "waltz."

Mr. H. M. Hartley, Balliol, read a paper on "Jöns Jakob Berzelius."

Mr. W. K. Spencer (Magdalen) has been elected to the Burdett Coutts' scholarship in geology.

The Chemistry School suffered a heavy loss at the beginning of the present term in Mr. Vernon Harcourt's resignation of the Lee's readership, which he held for forty-three years. Mr. Harcourt was a Balliol undergraduate, and in 1858 was placed in the first class in the Natural Science School. During the next year he was elected to the Lee's readership at Christchurch. In addition to his research work, he took an important part in the teaching of chemistry. He did not merely train his pupils in the ordinary curriculum required for the schools, but imbued them with the ambitions of the researcher, and it is a striking testimony to his efforts that the best experimental work by Oxford men of the present generation has come from those who were his own pupils or worked under his influence. His departure from Oxford will be greatly regretted by very many friends both young and old, and he will leave behind him a place which it will be very hard adequately to fill.

CAMBRIDGE.—In the combination room of Peterhouse on Wednesday of last week, Lord Kelvin unveiled a portrait of the late Prof. P. G. Tait, honorary fellow of the college, who was senior wrangler and first Smith's prizeman in 1852. The portrait, which was subscribed for by the master and fellows of Peterhouse, was painted by Sir George Reid, president of the Royal Scottish Academy, and it will be hung in the hall of the college by the side of the portraits of Lord Kelvin and the late Dr. H. W. Cookson. The *Times* reports Lord Kelvin to have said, in the course of his remarks, that he valued most highly the privilege of being allowed to ask the master and fellows of Peterhouse to accept for their college a portrait of Prof. Tait. He felt specially grateful for this privilege as a forty-years' comrade, friend and working ally of Tait. The master of Pembroke (Sir George Stokes) spoke of Prof. Tait as an intimate friend, and said all who knew him must have been impressed with his great ingenuity and the versatility of his genius.

Mr. F. C. Kempson, Caius, has been appointed a demonstrator of anatomy.

The following are the examiners for the natural sciences tripos:—Physics: Prof. L. R. Wilberforce, F.R.S., and T. C. Fitzpatrick; chemistry: C. T. Heycock, F.R.S., and H. McLeod, F.R.S.; mineralogy: A. Hutchinson and G. F. Herbert Smith; geology: H. Woods and Prof. T. T. Groom; botany: Prof. Ward, F.R.S., and D. H. Scott, F.R.S.; zoology: J. S. Gardiner and Prof. Graham Kerr; physiology: W. B. Hardy, F.R.S., and E. H. Starling, F.R.S.; anatomy: N. B. Harman and Dr. A. Keith.

Dr. W. H. R. Rivers, University lecturer in experimental psychology, has been elected a fellow of St. John's College.

Mr. H. O. Jones, Jacksonian demonstrator of chemistry, has been elected a fellow of Clare College.

DR. R. H. ADERS PLIMMER has been appointed Grocers' Company research student at the Jenner Institute of Preventive Medicine.

SIR GEORGE KEKEWICH, who has been secretary to the Board of Education since 1890, has resigned his appointment and has been succeeded by Mr. R. L. Morant.

DR. H. S. CARSLAW has been appointed professor of pure and applied mathematics in the University of Sydney. He was fourth wrangler (bracketed) in 1894, and is lecturer in mathematics in the University of Glasgow, and Fellow of Emmanuel College, Cambridge.

THE Vienna correspondent of the *Times* states that according to a communication from St. Petersburg, the Russian Ministry of Agriculture has just decided to found an agricultural high school for women. Students at the school will receive a general training as agriculturists, or will be permitted to restrict their attention to special branches of agriculture, such as dairy farming, gardening, bee culture, poultry keeping and cattle and sheep breeding. The course has been fixed for three years and will include practical occupation on a model farm in addition to study and laboratory work. Although the date on which the new institution will be opened has not yet been decided upon, 325 women who have had an intermediate education have announced their intention to follow the course.

A RESEARCH scholarship of the annual value of 200*l*. for the study of the thymus and other ductless glands has recently been founded by Mr. J. Francis Mason, of Freeland Lodge, Woodstock, Oxfordshire. The scholarship is tenable for two years, but the period may be extended to three years. The medical papers announce that on the recommendation of Prof. G. Sims Woodhead, of Cambridge, and Dr. T. F. S. Caverhill, of Edinburgh, Dr. Swale Vincent, lecturer on histology at the University College, Cardiff, has been appointed the first scholar. In addition to the foundation of the scholarship, Mr. Mason has made a donation of 200*l*. to the laboratory of the Edinburgh Royal College of Physicians to enable the medical superintendent, Dr. Noël Paton, to carry out a combined research on ductless glands.

THE chief of the circulating department of the New York Public Library has recently undertaken an inquiry into the kind and amount of the reading of scientific subjects which takes place in connection with the eleven branches of the New York Library. During May, 1901, the total home circulation of books from the eleven branch libraries was 131,700, and that of books of science 8553, or 6·5 per cent. The most popular subjects of science during the month concerned were, in order, zoology, mathematics, physics and botany, the least popular of the ten sciences tabulated being palæontology, on which subject there were only twenty-four books in all the libraries put together, and of these only four were borrowed during the month. But a month is too short a time for the investigation, and little importance can be attached to the results.

THE report of the Somerset County Education Committee for the year ending March 31 last shows that very few changes were made during this period in the system of technical education existing in the county of Somerset. The committee continues to encourage agricultural research. For instance, a grant of 100*l*. a year for three years has been made to the Bath and West and Southern Counties' Society in aid of a research by Mr. F. T. Lloyd into the causes of production of flavour in dairy produce, the Board of Agriculture contributing 200*l*. per annum and the Bath and West Society 150*l*. per annum for the same purpose during the same period. A grant of 25*l*. has also been made in aid of the expenses of experiments on the influence of the manuring of pastures on the growth of sheep fed thereon, to be carried out on Lord Ebrington's estate on Exmoor.

WE have received from Sir Philip Magnus the report, for the session 1901–2, on the work of the department of technology of the City and Guilds of London Institute. Among other matters described are the steps by which arrangements have been made for coordinating the technological work of the Institute with that of the Board of Education for England and Wales and of the Scotch Education Department. These arrangements are to be welcomed as helping to systematise technical instruction and as tending to prevent the overlapping of effort which, in educational matters, has generally led to waste and inefficiency. They mark another step towards the unification of different educational activities under a central board. The work of the department of technology of the Institute continues to grow steadily. During the session, the number of classes registered by the Institute increased from 2222 to 2320, and the number of students in attendance at these classes from 34,246 to 36,189. The total number of candidates for examination in Great Britain and Ireland was 16,580, showing an increase of 1023 on the number presented in 1901.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 15.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Mr. A. J. Chitty showed an entirely black specimen of *Metoecus paradoxus* as tending to disprove the mimicry suggested by him at the meeting on October 1. Dr. Chapman said that in his experience one out of every six specimens of this species was black. Mr. Donisthorpe stated that out of about one hundred specimens he had never caught or bred a black Metœcus.—Mr. E. P. Pickett exhibited a variety of the female of *Argynnis aglaia*, varieties of *Satyrus janira*, and a long series of *Lycaena corydon* taken near Folkestone and Dover in August last, including four males of the last-named species, with the black band on the edge of the forewings much deeper than usual; also twelve dwarf male specimens of this species, four dwarf females and many other aberrant forms. Mr. Goss said this dwarf form of *L. corydon* occurred constantly in one valley about two miles east from Dover, but he was unaware of its occurrence elsewhere in this country. He remarked that a dwarf form of *L. arion* occurred everywhere where the type was found, both in Gloucestershire and Cornwall. Dr. Chapman and Mr. Sloper also remarked on the dwarf form of *L. corydon*.—Dr. Chapman exhibited specimens of *Notodonta* (*Hybocampa*) *dryinopa* from Queensland. It was remarkably similar in appearance, structure and habits to *Hybocampa milhauseri*. He stated that the pupa with a similar spine to that of *H. milhauseri* does not cut out a regular oval lid from the cocoon like that species, but by a stabbing process pierces it with a number of holes, so that a piece is more easily pushed off. The cocoon being covered with bits of bark, stone, &c., a cutting process would be impossible, whereas the cocoon of *H. milhauseri* was of pure gum-like silk. He pointed out that the larva much resembled that of *H. milhauseri*, but the hinder segments were more like those of *Stauropus fagi*. He also exhibited living eggs, larvæ and imagines of *Orina tristis*, var. *smaragdina*, from Pino, Lago Maggiore. The beetles were taken on May 30, and had laid many eggs. Dr. Chapman said that the embryo, ready to hatch, might be seen within some of the eggs and its hatching spines observed.—Mr. Sloper exhibited a specimen of *Lycaena hylas*, caught at Dover on September 7.—Mr. Martin Jacoby communicated a paper entitled "A Further Contribution to our Knowledge of African Phytophagous Coleoptera."—Mr. Malcolm Burr read a communication from Hofrath Dr. Carl Brunner von Wattenwyl entitled "Observations sur le nom générique Acrida."

MANCHESTER.

Literary and Philosophical Society, October 21.—Mr. Charles Bailey, president, in the chair.—Mr. C. E. Stromeyer exhibited specimens of boiler scale which both internally and externally resembled volcanoes, and he thought might with advantage be studied with the object of gaining a knowledge of volcanic eruptions.—The president read a paper on the adventitious vegetation of the sandhills of St. Anne's-on-the-Sea, in which he remarked on four aliens found in that locality, viz. *Œnothera biennis*, Linn., *Sisymbrium pannonicum*, Jacq., *Ambrosia artemisiaefolia*, Linn., and *Vicia villosa*, Roth. Although the latter plant is distributed throughout Europe, this is probably the first record of its occurrence in Britain. *Ambrosia artemisiaefolia* is also a noteworthy addition, as it is a rare casual in the few places in England where it has previously been found.

PARIS.

Academy of Sciences, October 22.—M. Bouquet de la Grye in the chair.—Demonstration of the absolute irreducibility of the equation $y'' = 6y^2 + x$, by M. Paul Painlevé.—Synthesis of the alkaline hyposulphites and of the hyposulphites of the alkaline earths in an anhydrous condition, by M. Moissan. The hydrides of the alkalis and the alkaline earths when acted upon with sulphur dioxide under reduced pressure give pure hyposulphites, the hydrosulphites of Schutzenberger. From the fact that hydrogen is given off in this reaction, it is shown that the formula given by Bernthsen, $Na_2S_2O_4$, is correct, and that the original formula of Schutzenberger, in which these substances are represented as containing hydrogen, is not in accordance with fact.—The culture of wheat at the experimental field at Grignon in 1902, by MM. Dehérain and C. Dupont. Chiefly owing to the rains in the month of May, the yield of wheat in this experimental station has been exceptionally good. The

conclusion is drawn from this that where irrigation is possible in the spring without too great an expense, the results will be very advantageous to the farmer.—Some cases of integration of the equation to the brachistochrone, by M. Haton de la Goupillière.—On cavitation in screw steamers, by M. J. A. Bormand. The name cavitation is given to the phenomenon met with when a screw is driven in water at speeds above a certain limiting value. A cavity is formed in the water inside which the screw revolves, and a further increase in the power driving the screw then results in no increase in the velocity of the boat. The alterations necessitated in the usual formulæ for screw propulsion by this phenomenon are discussed in detail.—On the velocity of propagation of the X-rays, by M. T. Blondlot. By means of the action of the X-rays upon the discharge of a Hertzian exciter, it is shown that the duration of these rays is less than 5×10^{-10} sec., and that the velocity of the X-rays is of the same order as that of the Hertzian waves.—Remarks by M. le General Bassot on the volume of the *Connaissance des Temps* for 1905.—New observations on the volcanic eruptions at Martinique, by M. A. Lacroix.—Observations on the sun made at the Observatory of Lyons with the Brunner equatorial during the second quarter of 1902, by M. J. Guillaume. The results are summarised in three tables giving the number of spots, their distribution in latitude and the distribution of the faculæ in latitude.—On the theory of algebraic functions, by M. Ludwig Schlesinger.—On Bessel's equation with a second member, by M. A. S. Chessin.—On an example of correlative transformation in mechanics, by M Paul J. Suchar.—The precautions to be taken in the employment of silk fibres as torsion wires, by M. V. Crémieu —Vision at a distance by electricity, by M. J. H. Coblyn.—The variation of the magnetic resistance of a bar submitted to traction, by M. Fraichet.—The electromotive force of a thermoelectric element, by M. Ponsot.—A method for the volumetric estimation of tannin and the analysis of wood and of tannin extracts, by M. Albert Thompson. The method is based upon the determination of the amount of oxygen absorbed from an alkaline solution of hydrogen peroxide by the tannin.—On a new base derived from galactose, by M. E. Roux. By the reduction of the oxime obtained from galactose, a new base named galactamine is obtained, the preparation and chief properties of which are described.—On a new compound of the hexamethylene-tetramine group, by M. Marcel Descudé.—On a solid acid from the oil of *Elaeococca vernicia*, by M. L. Maquenne.—On musculamine, a base derived from muscles, by MM. A. Etard and A. Vila. The base described is the first example of a triamine base among biological products.—On the origin of the natural coloration of silk in the Lepidoptera, by MM. D. Levrat and A. Conte. These researches show the possibility of passing a substance such as a colouring matter through the digestive tube on to the silk, through the blood—On the new genus Gyrinocheilus of the family Cyprinidæ, by M. Léon Vaillant.—Contribution to the study of the Anopheles of the Isthmus of Suez, by M. Cambouliu.—The physical conditions of tuberisation in plants, by M. Noel Bernard.—Observations on the germination of the spores of *Saccharomyces Ludwigii*, by M. A. Guillermond.—On the pollen of plants belonging to the genus Asclepias, by M. Paul Dop.—New experiments in maritime aeronautics, by M. H. Hervé.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 6.

LINNEAN SOCIETY, at 8.—Notes on a Natural History Journey to Chile: H. J. Elwes, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Address by the President, Mr. Herbert Jackson.

CHEMICAL SOCIETY, at 8.—Di-Indigotine: J. Moir —Note on the Localisation of Phosphates in the Sugar Cane: C. H. G. Sprankling.—The Specific Heats of Gases: H. Crompton.—On the Non-existence of the Gaseous Sulphide of Carbon described by Deninger: E. J. Russell and N. Smith.—The Action of Nitric Acid on Bromophenolic Compounds: W. Robertson.—Hydroxyoxamides. Part II.: R. H. Pickard, C. Allen, W. A. Bowdler and W. Carter.—3:5-Dichlor-*o*-xylene and 3:5-Dichlor-*p*-phthalic Acid: A. W. Crossley and H. R. Le Sueur—Isometric Anhydrous Sulphates of the Form $M''SO_4,R'_2SO_4$: F. R. Mallet.—The Catalytic Racemisation of Amygdaline: J. W. Walker.—The Combination of Carbon Monoxide with Chlorine under the Influence of Light: G. Dyson and A. Harden—The Constituents of Commercial Chrysarobin: H. A. D. Jowett and C. E. Potter.

SATURDAY, NOVEMBER 8.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30 p.m.—Results of the Fungus Foray on October 17 and 18: Dr. M. C. Cooke.—Report of Delegate at British Association Meeting, Belfast: W Whitaker, F.R.S.—Lecture, "Insect Life": F. Enock.

TUESDAY, NOVEMBER 11.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Tramways: C. Hopkinson, B. Hopkinson and E. Talbot.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—On the Classification and Arrangement of the Exhibits of an Anthropological Museum: W. H. Holmes.—On the Initiation Ceremonies of the Natives of the Papuan Gulf: Rev. J. H. Holmes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—World-shaking Earthquakes: Prof. J. Milne, F.R.S.

THURSDAY, NOVEMBER 13.

MATHEMATICAL SOCIETY, at 5.30.—Address on the Infinite and the Infinitesimal in Mathematical Analysis: Dr. E. W. Hobson.—Ueber den Satz der Gleichheit der Basiswinkel im gleichschenkligen Dreieck: Dr. D. Hilbert.—The Summation of a Certain Series: Prof. A. C. Dixon.—Expansion by Means of Lamé's Functions: Prof. A. C. Dixon.—Sets of Intervals: W. H. Young.—Note on Unclosed Sets of Points defined as the Limits of a Sequence of Closed Sets of Points: W. H. Young.—Wave Propagation in Two Dimensions: Prof. H. Lamb.—The Continuation of Certain Fundamental Powers Series: Prof. M. J. M. Hill.—A Geodesic on a Spheroid and an Associated Ellipse: L. Crawford.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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SUPPLEMENT.

SUPPLEMENT TO "NATURE."

THE HISTORY OF EGYPT.

A History of Egypt from the End of the Neolithic Period to the Death of Cleopatra VII., B.C. 30. 8 vols., illustrated. Books on Egypt and Chaldæa, vols. ix–xvi. By E. A. Wallis Budge, M.A., Litt.D., D.Lit., Keeper of the Egyptian and Assyrian Antiquities in the British Museum. (London: Kegan Paul and Co., Ltd., 1902.) Price 3*s*. 6*d*. per vol.

IT is now twenty years since Egypt last changed masters, and the completion of these twenty years of British rule has been marked by the completion of a work of public utility, the great dam at Aswân, which will surpass any similar work carried out in the days of the Pharaohs. Simultaneously is published the fullest and most complete English history of Egypt under her ancient native monarchs, from the earliest times to the end of the native kingdom, a period of more than four thousand years. The publication consists of eight small and very handy volumes, all profusely illustrated with photographs and line-drawings of temples, tombs, mummies and other antiquities of the various periods, which are treated in succession. Dr. Budge may be congratulated on the production at a most opportune moment of this work, which should find a place on the shelves of everyone who is interested in the past history of the famous land which we have taken under our protection.

The history is described on the title-page as beginning with the end of the Neolithic period. But in reality Dr. Budge begins earlier than that, for Egypt was inhabited in Palæolithic days, and the fact is chronicled by her historian, who also engraves several flint implements, now in the British Museum, which are undoubtedly of the Older Stone Age (p. 85). All anthropological inquirers will be grateful to Dr. Budge for the large number of illustrations which he gives in his first volume of the weapons, implements, vases, &c., which were used by the earliest Egyptians. The Neolithic Egyptian weapons are beyond doubt the finest ever discovered, the masterpieces of the Neolithic knapper, and those who are familiar only with European or East-Asiatic types will open their eyes when they first become acquainted with those of Egypt. The vases can hardly be believed to have been made without the wheel. Yet they undoubtedly were; neither the wheel nor the lathe were known to the early Egyptians. The Neolithic vase-types, the oldest of which is the well-known red and black ware, gradually progress until they merge insensibly into those of the earliest dynastic period, which was "Chalcolithic" in character, *i.e.* copper had then come into general use.

Dr. Budge describes very fully the probable manner of life of the earliest Egyptians, his authorities being their own relics and the many valuable hints which are given us by the Sicilian historian Diodorus. He also makes clear the whole history of the discovery of these primitive inhabitants of the Nile Valley, showing how their remains were known in many museums years ago, but could not be classified, being often set down as forgeries simply because they were extraordinary; how Prof. Petrie and M. de Morgan made a series of independent but contemporary explorations, which resulted in the discovery of whole cemeteries of the "New Race" (the people to whom these extraordinary objects belonged) and of numbers of these objects, chiefly flints and vases, themselves; how the problem of the chronological position of these remarkable remains arose, and how M. de Morgan dated them rightly and Prof. Petrie wrongly; finally, how the English savant was convinced that the arguments of his French confrère were correct, with the result that all archæologists are now agreed that these remains are veritably those of the Egyptians of the later Neolithic and early Chalcolithic periods. All this, and more, is set forth in most interesting fashion by the Keeper of the National Collection of Egyptian Antiquities.

From the Predynastic period, to which the Neolithic antiquities belong, Dr. Budge proceeds to the discussion of the remains of the Early Dynastic or "Archaic" period, which was "Chalcolithic" in character, as has been already observed above. Here again the historian performs the necessary function of impartially dealing out to each explorer and archæologist the exact meed of due renown to which he is entitled for his particular services to the cause of science in the matter of the discovery and elucidation of the tombs of the earliest dynasties. Prof. Petrie's scheme for the arrangement of the earliest kings is more or less accepted, with the exception of "Dynasty O," of which the author makes no mention, probably because the phrase is a contradiction in terms, since "Dynasty O" is no dynasty. That there were local kings in both Upper and Lower Egypt before Menes is of course probable; indeed, Dr. Budge is, so far as we are aware, the first to point out that a very ancient monument, the Palermo Stele (Fifth Dynasty, about 3500 B.C.), contains the names of a whole series of hitherto unsuspected predynastic monarchs of Lower Egypt, which names, Seka, Tau, Thesh, Mekha, &c., are of a most primitive character (vol. i. p. 169). Since, however, these kings, as well as others (of Upper Egypt) identified at Abydos are mere local monarchs of the ages before Mena, they can hardly be said to belong to any "dynasty" at all, for the dynasties of All Egypt begin with Mena; and the use of the term "dynasty" for these predynastic chiefs is evidently deprecated by Dr. Budge.

In the chapter with which the second volume commences, Dr. Budge describes the advance which the "Archaic" Egyptians had made upon their ancestors of the predynastic time. The civilisation of the Archaic people he does not regard as indigenous, but as an importation from farther east, probably from Southern Arabia. He certainly seems to show that there are undoubted traces of strong Sumerian (Early Babylonian) influence in the archaic civilisation of Egypt which are absent from the older Neolithic barbarism. Further, writing begins with the dynasties. Taking these facts in conjunction with the indications supplied by several Egyptian legends (of great interest to the student of early traditions), he comes to the conclusion that the indigenous stone-using people, who were akin to the Libyans, were overrun at some period previous to the unification of the country under one king by a conquering, more highly civilised people from the east, who used copper weapons. This people invaded the Nile Valley

from the Red Sea coast by way of the Wady Hammamat. This version of a theory which has long been broached and discussed seems more probable than any other, because it does not go too far or ask us to believe too much.

From the Archaic Period, which came to an end with the Third Dynasty, about 3800 B.C., the historian passes on to the period of the great Pyramid-builders of the Fourth Dynasty, the days of the mighty Cheops, Chephren and Mykerinos, so well known to us from the pages of the Father of History. And it is wonderful how well informed Herodotus was about these ancient kings, who seem to have impressed themselves on the memories of their subjects for all time. With the Fourth Dynasty, Egyptian civilisation ceased to develop with the remarkable vigour and quickness which it had shown during the Archaic Period, and became more or less stereotyped. For many centuries, therefore, the task of the historian is the simple one of recording the reign of king after king, war after war, until with the accession of the Eighteenth Dynasty Egypt became a world-power, and subdued mankind from the marshes of the Bahr al-Ghazal to the mountains of Armenia, from the plains of Babylonia to the passes of the Taurus, to her sway. The strange reign of the religious and artistic enthusiast Khu-en-Aten is described, and the story of his shameful abandonment of the Asiatic empire of Egypt and its partial reconquest by Seti I. and his pretentious son Rameses II. (who has, it appears, no particular claim to the title "Great," which is usually bestowed upon him) is retold by Dr. Budge, and the interest of the tale is much enhanced by the contemporary illustrations of these ancient wars and sieges which he reproduces for us. We are speaking now of the fourteenth century B.C., three thousand years after the Archaic Period which we have just been discussing—*i.e.* as much time lies between the days of those monarchs of old, Mena and the rest, and the wars of Rameses and Seti as lies between these and our own day. This may give some idea of the expanse of time which Egyptian history covers. Yet Babylonia was already civilised when Egypt was inhabited by Neolithic savages. At least, so Dr. Budge's conclusions would seem to show.

Many interesting hints are given by Dr. Budge as to the relations between the Egyptians and the peoples of Southern Palestine from the fourteenth century B.C. onwards. He discusses the question of the Exodus very fully, and describes the rise of the Jewish kingdom after the final withdrawal of Egyptian authority during the time of the *rois-fainéants* of the Twentieth Dynasty. Henceforward the Egyptians merely made periodical raids into Palestine, as under Shishak (950 B.C.) and Necho (600 B.C.), with interludes of Assyrian and Ethiopian invasion and conquest of Egypt itself, which now had sunk to the position of the proverbial "broken reed, upon which, if a man lean, it shall pierce his hand," and was ripe for the Persian yoke and the Macedonian deliverance, which was to bring Egypt within the fold of Hellenism.

In the preface to the sixth volume Dr. Budge's tone becomes strongly controversial and, we think, righteously so, for he is tilting at a great error which has had widespread and most unfortunate consequences; we refer to the erroneous conjectures of a German Assyriologist, Dr. Winckler, as to the existence of a country in Arabia called Musri, which have formed the foundation of a series of most amazing theories, enunciated by one of "the ablest of the higher critics," as Dr. Budge courteously describes him, Prof. Cheyne, of Oxford, on the subject of the early history of the peoples of Palestine. The first note of warning against these theories and their source, the baseless conjectures of Dr. Winckler, was sounded in a review which appeared in NATURE for June 26 of the present year (vol. lxvi. No. 1704) of the third volume of the "Encyclopædia Biblica," in which publication Prof. Cheyne's theories about his "Jerahmeelites" are enshrined. Quite lately, on September 25 last, a review signed with the initials R. C. T. also appeared in these columns, which dealt specifically with the theories of Dr. Winckler, and proved them errors step by step and point by point. Dr. Budge's preface covers much the same ground as the reviewer's article, but is fuller, and, as was to be expected in a popular work, not so technical in its phraseology. His final paragraph is worth reading, and should finally dispose of "Musri" and his son "Jerahmeel." It is rarely, we should think, that one eminent man of science has felt compelled to write so severely of the work of another as Dr. Budge has written of the Jerahmeel theory; yet we confess we think that Prof. Cheyne fully deserves the castigation which Dr. Budge has administered to him; he should realise that a mare's nest does not necessarily become a "brilliant and inspired theory" merely because a German discovered it. There is too much of this *Bauchrutschen vor Deutschland* among our archæologists and Biblical critics, and Dr. Budge has made a timely protest against the absurd habit.

Dr. Budge does not leave the Hellenistic period of Egyptian history outside the scope of his work. His last two volumes contain a very complete summary of the events of the Ptolemaic period, which should be useful to classical students. So far as we remember, the older histories of Egypt, such as Brugsch's "Egypt under the Pharaohs," Wiedemann's "Geschichte," Erasmus Wilson's "Egypt of the Past," &c., come to a close with the end of the *native* kingdom, with the flight of King Nekhtnebf before the Persians, about the middle of the fourth century B.C., and not long before the coming of Alexander the Great. Dr. Budge, however, does not regard his task as ended at this point, for, as he points out, although Egypt was ruled by Greek kings during the Ptolemaic period, she still remained an independent kingdom, and these Greek kings were Egyptian Pharaohs and nothing else. So he goes on with his tale until the death of Cleopatra and the Roman conquest finally bring the independent career of Egypt to an end.

Astronomers will be interested to note Dr. Budge's scepticism as to the possibility of any very trustworthy data for Egyptian chronology being obtained from astronomical calculations which involve consideration of the "Sothis period" (on Dr. Mahler's methods, for instance), while at the same time he accepts Sir Norman Lockyer's calculations in "The Dawn of Astronomy" of the probable dates of the foundation of various Egyptian temples, based upon a consideration of their orientation. This, however, is a very different matter from juggling with Sothis periods, Set festivals and the like, and the production of

an exact date for Thothmes III. from under your hat. "Astronomical evidence," says Dr. Budge (i. p. 158), "supports the evidence derived from every other source in assigning a remote antiquity to the period when Egyptian civilisation began; but unfortunately it does not assist us in formulating a complete system of Egyptian chronology with exact dates."

Altogether the work is of great interest, and will no doubt prove of use to the scientific student as well as to the lay inquirer; and it is a monument to the industry of its author.

MOHR ON THE DYNAMICAL THEORY OF HEAT AND THE CONSERVATION OF ENERGY.

Die Entwickelung unserer Naturanschauung in XIX. Jahrhundert und Friedrich Mohr. By Ch. Jezler. Pp. 44 and portrait of Mohr. (Leipzig: Barth, 1902.) Price 1.20 Mark.

MOHR, the apothecary and chemist, is a name that will ever be associated with the foundation of the methods of volumetric analysis. Mohr as a controversialist in the domain of speculative geology is not so generally known, and Mohr as a pioneer in connection with the dynamical theory of heat and the doctrine of the conservation of energy is so little known that his writings have had to be rescued from oblivion by the author of the present pamphlet.

The work under consideration formed the subject of a communication to the Society of Natural Science at Winterthur in December, 1900, and while the paper was being prepared for publication there appeared in the *Berichte* of the German Chemical Society for April, 1900, the "Reminiscences of Friedrich Mohr," by Hasenclever, who knew Mohr personally, and who deals more particularly with his correspondence with Liebig. It appears, however, that one of the two most important works published by Mohr in 1837 escaped the notice of Hasenclever, and it is upon this particular work that Herr Jezler more especially bases Mohr's claim for prominent recognition among the founders of modern science.

The pamphlet which has been submitted for consideration is certainly worthy of very careful attention by all who are interested in tracing the history of one of the greatest generalisations in physical science of the nineteenth century. The first section deals with the development of science as a whole, and is to be regarded as a kind of background in which the figure of Mohr is framed. The second part gives the detailed account of Mohr's work with copious extracts from his published papers, some of the early communications to the first volume of *Poggendorff's Annalen* having given the author no little trouble to obtain on account of their scarcity. The general impression which the reader must form is that Mohr's claim to take high rank among the scientific worthies of the past rests on a very much broader basis than has generally been conceded. Passing over the evidence of his many-sided activity in other departments of science, it is unquestionably in connection with the development of the modern conceptions of heat as a kind of motion and of the "unity of forces" (*Einheit der Naturkräfte*) that the greatest interest will be aroused.

In order to fit Mohr into his proper place, the author expands the three scientific achievements of the past century as classified by Haeckel into four:—(1) The doctrines of the indestructibility of matter and energy; (2) the theory of the correlation or unity of natural forces; (3) the establishment of chemistry as an independent science; and (4) the development of physiology and biology and the Darwinian theory. There is, perhaps, scope for criticism in the proposed classification, but it is not essential to the author's main contention whether this scheme be rigidly adhered to or not. It will suffice to mention that under each of the four headings he gives a brief historical *résumé*. The treatment is necessarily very scrappy, owing to the small amount of space which the author has allowed himself considering the enormous field which he has had to cover. It is clear, however from the facts submitted under the heading of "the theory of the indestructibility of force" and elaborated in detail in the second part of the work that Mohr's views were formulated with considerable precision and published some five years before R. Mayer's first paper on this subject in 1842. In chronological order, Herr Jezler therefore names in connection with this generalisation Carnot, Mohr, Mayer, Joule, &c.

A somewhat acrimonious (and unscientific) controversy raged in this country many years ago respecting Mayer's claims to priority. The writer of this notice has not the least desire to stir up the ashes of this dead strife, but admitting Mayer's claims, it is interesting to learn from the pamphlet before us that Mohr himself drew Mayer's attention to his earlier publications and that a correspondence took place in the course of which Mayer wrote:—

"In dem wichtigen und sehr geistvollen Aufsatze, welchen Sie in ihrem neuesten Werke 'Die mechanische Theorie der chemischen Affinitat' zitieren, haben Sie unstreitig die mechanische Warmenlehre ausgesprochen und haben sogar das Wärmäquivalent numerisch zu bestimmen gesucht."

The reference which Mohr makes in this later work quoted by Mayer is to his first paper of 1837, entitled "Ansichten über die Natur der Wärme" (*Annalen der Pharmacie*, vol. xxiv. p. 141). In this same letter it may be mentioned that Mayer claims priority over Joule in the determination of the mechanical equivalent of heat. Mohr's second paper of 1837 is entitled "Ueber die Natur der Wärme," and a quotation from this paper given in the present pamphlet (p. 10) shows that Mohr had fully realised the principle of the "correlation of the physical forces," as it was afterwards called by Grove in his celebrated work bearing this title. The historian of this branch of physical science, Max Planck ("Das Prinzip der Erhaltung der Energie," Leipzig, 1887), in pushing Mohr's claim, appears also to have depended only upon this second paper and to have overlooked the first paper. Reading this contribution now *in extenso* as it is reprinted in the pamphlet, it is remarkable to find how closely Mohr approximated in the year 1837 to the current views held by physicists and chemists. The subject was certainly in the air, but Mohr was apparently too far in advance of the time, for his papers fell into oblivion until he himself reminded his contemporaries of their existence. As is pointed out, however, in the

present lecture, the fundamental importance of the conception of heat as a form of energy was not grasped by the then editor of the *Annalen*. It seems that at first even Mayer's work was more appreciated abroad than in his own country, and the great work of Joule, whose first communication was published in 1843, was not noticed in the *Annalen* until 1848, while his second memoir, published in the *Philosophical Transactions* in 1850, was noticed in *Poggendorff's Annalen* only in 1854. It is not surprising in these circumstances that a writer who failed to enforce his views—although we now know these to have been perfectly sound—by original experiments should not have succeeded in turning the direction of contemporary scientific thought by two philosophical essays which, bearing in mind the date of their publication, were little short of revolutionary. But it certainly is remarkable that his contributions should have been altogether overlooked by later writers who were, and are, fully cognisant of the importance of the doctrines in question. Thus in the list of names given by Father Secchi in 1878, that of Mohr does not appear. In a lecture on the development of the exact sciences during the nineteenth century given by Prof. van 't Hoff before the German Association in 1900, it is pointed out that the law of the conservation of energy, although essentially a physical discovery, was not made by physicists in particular. He mentions Mayer the physician, Joule the brewer, Colding the engineer, and especially Helmholtz, at that time a physiologist. Herr Jezler adds:—

"Warun hier nicht als erster Mohr, ein Apotheker, genannt werden soll, ist mir unbegreiflich. Auf Grund vorliegender Experimentalforschungen (Melloni, 1798 bis 1854) kam Mohr durch Induktion zur dynamischen Warmelehre im Gegensatz zu der gebrauchlichen materiellen Warmetheorie, durch Deduktion gelangte er . . . zur Einheit der Naturkrafte, gleichbedeutend mit dem Prinzip der Erhaltung der Kraft."

Cases similar to Mohr's, in which important new conceptions have been started by men who failed to influence contemporary opinions, are well known in the history of science. Sometimes recognition has come during the worker's lifetime, as with Newlands and the periodic law—which example, by the way, is not referred to by the writer of the present pamphlet, although he mentions several other cases. Generally, however, the recognition is posthumous. As an instance of this we have Waterston's anticipation of the kinetic theory of gases, rescued from the archives of the Royal Society by Lord Rayleigh. When by masterly and convincing treatment some great generalisation which has been in the air for some time previously is finally made evident to the scientific world by the stroke of genius, there is always a danger of reading too much into the works of the earlier investigators and of interpreting their results in the light of later knowledge. The writer of this notice ventures to quote by way of illustration the enormously enhanced reputation of Lamarck as an evolutionist since the publication of the "Origin of Species." Is it going too far to say that Charles Darwin has made the reputation of Lamarck? In the case with which we are immediately concerned, however, a candid examination of the evidence will, we believe, show that Herr Jezler has not credited Mohr with more than was due to him.

R. MELDOLA.

SOIL SURVEYS.

Field Operations of the Division of Soils, 1900. By Milton Whitney, Chief (U.S. Department of Agriculture). Pp. 474 + a case containing 24 maps. (Washington, 1901.)

PERHAPS one of the greatest services which the scientific man can render to the agricultural community in any country is the classification of the soils into certain types, defined by their chemical or physical properties, and the allocation of these types to their appropriate areas, so as to obtain a soil map of the district in question.

Despite disturbing factors, certain types of soil persist over wide stretches of country and are characterised by a general physical and chemical resemblance, and also by a corresponding similarity in natural flora, appropriateness to particular crops and responsiveness to certain kinds of manure. The constancy of these soil types is the result of a common origin from the same kind of rock, and the difficulty lies less in recognising the type than in tracing its boundary line.

As a fundamental basis comes the geological survey, particularly the "drift" maps showing the superficial deposits due to running water, ice, &c., which, though of no great geological importance, are the origin of the soil proper. But for the purposes of a soil survey a little more than even a "drift" map is wanted; further subdivisions must be introduced to show changes in soils on the same formation due to variations in the lithological character of the formation, or those due to the sorting action of water in the case of soils of transport.

These variations, in fact soil classification generally, must be based upon physical structure, must amplify and give exactitude to the practical man's division into clays, loams and sands; the chemical properties of the soil may vary concurrently, but are too much subject to casual change to serve as prime means of distinction. As an instance, the upper beds of the Lower Greensand in east and mid Kent give rise to rich loams, on which many fine hop and fruit plantations are situated; further west the formation gradually changes, until in west Surrey and Hampshire it is barren heath land the soil of which is alike wanting in the finer "clay" particles, carbonate of lime and the soluble salts which go to feed the plant. Again, in the book under notice many examples will be found of two or more distinct soils of the same origin, *e.g.* the maricopa soils (p. 302), described as consisting of "colluvial materials . . . largely granite . . . divided into four soils, depending upon the degree of comminution of the rock."

The volume before us represents a year's work of the Division of Soils of the United States Department of Agriculture in this particular direction of constructing a series of soil maps; twenty-four of the maps are given on a scale of 1 inch to the mile, and show, by a system of colouring similar to that of a geological map, the type to which the soil belongs. The accompanying text gives a mechanical analysis of the type soil, *i.e.* its division into fractions each consisting of particles of a certain size, and in some cases a chemical analysis, also such information collected on the spot as the distance to ground water, climatic features, characteristic crops or natural flora and other local economic conditions.

It was found, according to Mr. Whitney's preliminary review,

"that it was quite possible to map these soil areas independently of the geology of the area, or the exact chemical or physical character of the soil; that the proper course was to construct maps in the field, showing the area and distribution of the soil types; to explain as fully as possible from geological considerations the origin of the soil and to leave the soil chemist and physicist study the differences. The fact is recognised that these chemical and physical properties of soils are so complex and difficult that it may take many years to explain them through laboratory investigation; but, pending this complete investigation, the maps themselves will be of the utmost value to agriculturists in indicating the areas over which certain soil conditions are found to prevail. . . . The recent successful growing of Sumatra tobacco on a certain soil in the Connecticut Valley is a very striking instance of the possibilities growing out of the detailed soil survey in any given locality."

The whole work is an excellent example of the thoroughness with which America carries out her State services; the maps themselves are clear and distinct; some of them, like the Saint Ana (California) sheet, represent a very complex distribution of soils, the survey of which must have involved no light amount of field work, while the accompanying text is most liberally illustrated with analyses, sketch maps and sections, and photographs illustrative of scenery, crops or vegetation, the ease with which photographic illustrations are now produced being perhaps responsible for the trivial nature of one or two of the objects selected.

Several of the sections of the survey deal with that interesting factor in all arid or semi-arid areas, the existence of alkali soils and their extension under irrigation, which is, unfortunately, almost the only method of farming possible. Alkali is used in a generalised sense as indicating any predominance of soluble salts, generally sulphates and chlorides of sodium, magnesium and calcium, in the ground water, so that vegetation is destroyed or restricted to certain "salt" plants, and on occasion the salts effloresce in a white powder on the surface. Sometimes carbonates of the alkalis are also present, which by their injurious action upon the texture of the soil and their solution of the humic acids give rise to "black alkali" spots, more dreaded even than the white. These "alkalis" probably represent nothing more than the normal products of the weathering of the fundamental rock minerals, but owing to the limited rainfall there is no percolation through soil and subsoil, to wash everything soluble into the rivers. Instead the salts remain in the subsoil, and irrigation, by raising the level of the ground water, may easily bring the salts so near the surface that they rise in the capillary water to the surface and there are crystallised out. An instance of the damage due to careless irrigation and the rise of the subsoil water is given in the report before us in the account of the Salt River Valley, Arizona.

The phenomena of alkali soils and their increase through irrigation are neither new nor confined to the United States; any arid climate where the products of weathering are not removed in the "country drainage" shows the same problem. Our irrigation engineers in India and Egypt are regularly confronted with the problem, for which there is only one solution, underdrainage so that the cultivated soil may be washed from time to time, and careful cultivation to minimise all evaporation from the soil except through the leaves of the crop. But though the "alkali" problems are common in the old world, it has not been until the time of Hilgard, Whitney and the present Division of Soils in the U.S. Department of Agriculture that we have had any real knowledge of their composition, or any study of the physical and chemical principles underlying the movement of the injurious material in the soil.

The character of the information provided by a soil survey must largely depend upon the nature of the country; in many parts of the United States agriculture is so recent that there is no accumulation of experience as to suitable crops, hence the survey, by comparison of the texture of the soil, the climatic features, depth to ground water, &c., with the conditions prevailing in known areas, can directly advise the settler with what crops he is most likely to succeed.

But in a country like our own, the land has been under cultivation so long that a great mass of local information, based upon experience, exists as to the character even of individual fields. Hints as to methods of cultivation or cropping based upon analysis are likely to be too general to be of any service; the chief application is rather the information that can be afforded as to the use of manures, for enormous economies could still be effected in the manure bill of nearly every farmer who buys artificial manures, if they were properly adapted to his soils and crops.

In Britain, the great initial want is the publication of drift maps of the Geological Survey on the six-inch-to-the-mile scale; were this in existence, it could be rapidly supplemented by the work of the local agricultural colleges until every farmer could be put in possession of that exact knowledge of his soil which is fundamental for all farming operations.

A. D. H.

AN ADVANCED TEXT-BOOK OF BOTANY.

A University Text-book of Botany. By Douglas Houghton Campbell, Ph.D. Pp. xv + 579. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 17*s.* net.

THERE are probably few books that are much harder to write than those which endeavour to deal, within a limited space, and from the point of view of the needs of the advanced student, with the whole range of any extensive branch of science. And indeed it is perhaps doubtful whether the time has not gone by when such works can hope to lay claims to much educational utility. Certainly this is the case as regards botany, which now covers so wide an area of knowledge that a bulky volume would be required merely to indicate in outline the more salient facts and their general connections and bearings.

The impression seems to be gaining ground that, for students of university type at least, a better method of treatment lies in the endeavour to expound on more truly scientific lines the facts embraced in its smaller subdivisions rather than in an attempt to range over the whole science in the course of a few hundred pages. And we think this modern tendency is a good one. The student who is hurried over so large a field of knowledge

can hardly hope even to scratch the surface, much less seriously to cultivate any part of it. He certainly will not receive that kind of training which goes to form a critical judgment on facts and inferences, although the imparting of this ought to be one of the chief objects of all higher education, whether of a scientific character or otherwise. It is this conviction that obliges us to confess that we think Prof. Campbell has set himself a difficult—if not, indeed, an impossible—task, and we cannot avoid a feeling of regret that he should have decided at all "to present in as compact a form as possible an outline of the essentials of modern botany." It is not that the book is not good of its kind—of which many already exist—but we doubt the intrinsic usefulness of its aims, even admitting these to have been realised. At any rate, the results, in so far as taxonomy, morphology and physiology are concerned, are certainly disappointing. The information given is of necessity ofttimes scrappy, and especially is this the case in the chapters dealing with classification. The student would scarcely find any other use for them than as mere statements to be learnt by heart. He would assuredly experience frequent difficulty in ascertaining on what rational basis the systems of classification themselves are erected.

By far the best part of the book is that devoted to a consideration of the geological and geographical distribution of plants. It contains much excellent matter, and may be heartily commended to students. Perhaps one might be inclined to take exception to a statement here and there, as, for example, the assertion that man is a very necessary agent in effecting the wide tropical distribution of the coconut.

But if our judgment on the book regarded as a whole appears to be a somewhat adverse one, this is not due to the way in which Prof. Campbell has executed his self-imposed task; our quarrel lies rather with the nature of the task itself. Nevertheless, the book, considered as a work of reference rather than as a text-book for the average student, may probably prove decidedly useful. It appears to contain very few errors, and the figures are numerous and, on the whole, excellent.

EMBRYOLOGY OF THE LOWER VERTEBRATES.

Lehrbuch der vergleichenden Entwickelungsgeschichte der niederen Wirbeltiere, in systematischer Reihenfolge und mit Berucksichtigung der experimentellen Embryologie bearbeitet. By Prof. Heinrich Ernst Ziegler. Pp. xii + 366; 327 figures and a coloured plate. (Jena: Gustav Fischer, 1902.) Price 10 marks.

THIS volume marks the tendency to increased specialisation in text-books, for it is an embryology of *the lower Vertebrates.* It also fills an obvious gap, for Balfour's classic work is acknowledged to be out of date, the large cooperative treatise now being edited by O. Hertwig is on an altogether bigger scale and different plan, the works of Bonnet, Kollman, Minot and O. Schultze deal with man or with mammals, and even in the well-known text-books of Hertwig and Milnes Marshall the lower Vertebrates are somewhat overshadowed by their successors, the Amniota. Thus there is room for Prof. Ziegler's volume, at which he has laboured, he tells us, for a dozen years. The result seems to us to justify his carefulness.

We would first remark on some of the distinctive features of the book as a whole. (1) Most attention is paid to the earlier stages in development; thus gastrulation and germ-layer-formation have more space than organogenesis. (2) While prominence is given to morphological ideas, the salt of which does not lose its savour, much attention has been paid to the trustworthy results of recent work in experimental embryology. (3) In regard to some of the more important moot points, the author gives a just statement of conflicting interpretations; in regard to others, he frankly states that he has given prominence to the view which his own investigations have led him to confirm or to formulate. (4) Very useful to the student are the numerous foot-notes which define the more difficult technical terms as they occur in the text, and sometimes include little side excursions of pleasant interest. (5) The bibliography at the end of each chapter is very full, but it has been put through a sieve, and, to avoid needless repetition, much of the older literature (given in Balfour's "Embryology," &c.) has been omitted. (6) There is an illustration on almost every page, and while there are many old friends (only eighty-seven from other text-books), seventy-four are Ziegler's own.

The first chapter gives recipes for preservation, and hints as to sectioning, model-reconstruction (of which the author's father was one of the pioneers), photography and the like. In the second chapter, there is a general sketch of the development of Vertebrates, with an exposition of technical terms. Perhaps the most interesting section is that in which the developmental processes in the foundation of organs are summarised: cell-movements; differentiation; unequal growth; curvature, folding and tube-formation; evagination and invagination, formation of villi and diverticula; proliferation; and splitting. Emphasis is laid on the familiar but difficult distinction between palingenetic and cœnogenetic processes, and it is further noted that complications arise by what may be called temporal and spatial shuntings (Heterochronien und Heterotopien), when an organ of increasing importance appears more and more precociously, *e.g.* the heart in Amniota, and when the seat of formation is altered, as in the shifting of the Blut-Anlagen from mesoderm to endoderm in Amphibians.

The succeeding chapters, forming the body of the book, deal with the lancelets, Cyclostomes, Selachians, Ganoids, Teleosts, Dipnoans, Amphibians and Gymnophiona; and the last chapter, on the Amniota, shows how the development of the lower Vertebrates sheds light upon that of the higher. We find these chapters lucid and interesting; the material is freshened, if not as yet greatly illuminated, by the incorporation of the experimental results; the notes (at the head of important sections) on the most essential memoirs and on demonstration-material will be of service to other teachers; and there is a fresh, stimulating atmosphere about the whole book. In evidence of its up-to-dateness, we may note that it includes the work of Dean on Bdellostoma, Graham Kerr on Lepidosiren, Brauer on Hypogeophis, and so on.

A brief indication may now be given of the author's

attitude to various general problems. It is, on the whole, conservative. His embryological studies leave him more than ever convinced of the unity of the Vertebrate phylum; the different modes of cleavage can be readily unified, but there seems no doubt that the discoidal mode has arisen several times independently; the processes of gastrulation (archi-, amphi- and disco-gastrula) can also be unified as Haeckel maintained; the two ways in which the medullary canal arises are connected by transitions, *e.g.* in Lepidosiren; the neurenteric canal, which had originally a nutritive significance, is another unifying character; and so on. It is more difficult to give a unified account of the mesoderm, which may arise by pouching, by splitting off, or by a proliferating process. "But," as the author says, "one cannot ignore the fact that all the modes of formation which occur in Vertebrates are connected by transitional stages." Against the prevalent view that the mode of origin by pouching, familiar in Amphioxus, is primitive, Ziegler maintains that the Vertebrate mesoderm arose originally as a proliferation on each side of the blastopore-margin, and subsequently spread forwards along the dorsal wall of the archenteron. In spite of some objections, which are not ignored, the author remains a firm adherent to the doctrine of the distinctiveness and "specificity" of the germinal layers—"one of the most important results of embryological research." In his concluding words, the author expresses the mood of the whole book when he says that embryology is luminous only in the light of the evolution-idea.

J. A. T.

TWO BOOKS ON AMERICAN SPORT.

The Deer Family. By T. Roosevelt and Others. Pp. ix + 334; illustrated.

Salmon and Trout. By D. Sage and Others. Pp. x + 417; illustrated. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1902.) Each volume 8*s.* 6*d.* net.

BOTH these works belong to the "American Sportsman's Library," of which Mr. C. Whitney is editor, and both fully maintain the high standard of excellence set by their predecessor in the same series, "Upland Game Birds." President Roosevelt, whose name appears first on the title-page of the volume on deer, is an excellent type of the best class of naturalist sportsmen, and of his three coadjutors Dr. D. G. Elliot, who writes on caribou, is a zoologist of high reputation, while Mr. A. J. Stone, who treats of the moose, is a famous Alaskan explorer and field-naturalist. Mr. Roosevelt, who contributes a thoughtful introduction to the volume, describes the deer of the Rocky Mountains and Eastern America as well as the prong-horn antelope; while the deer of the Pacific coast fall to the lot of Mr. T. S. Van Dyke. The only disadvantage we see in this arrangement is that the mule-deer is described twice over.

In his introduction, Mr. Roosevelt refers to the different views entertained as to the number of distinguishable forms of American deer and their nomenclature, but sums up by observing that there are only six wholly distinct kinds, the moose, the caribou, the wapiti, the whitetail, the mule-deer and the blacktail. With this philosophical view we are thoroughly in accord, and if all zoologists would but agree to regard these, and these only, as *species*, the subject would be much simplified. It is satisfactory to note that Dr. Elliot takes practically this view in his chapter on the various local forms of caribou. In consequence, apparently, of the divergent views prevalent in regard to nomenclature, Mr. Roosevelt very wisely avoids scientific names altogether, although such names do appear on the valuable maps showing the range of each species, which have been contributed to the work by Dr. C. H. Merriam.

The great decrease which has taken place of late years in the numbers of American big game is deplored by Mr. Roosevelt, who nevertheless urges that if proper game-laws be enacted and adequately enforced and "sanctuaries" established, most or all of the species may be preserved for many years to come. The professional skin and trophy hunter is the man who does most harm to big game, and next to him the "big-bag" sportsman, who receives a severe "slating" at the hand of the President.

Limitations of space forbid any detailed notice of the text, and it must accordingly suffice to say that in the case of each species attention is very fairly divided between the natural history and the sporting aspects of the subject; in fact, the whole volume is just what a work of this nature ought to be. The authors have been specially fortunate in their artists, among whom the name of Mr. C. Rungius occupies the post of honour. Among the numerous full-page illustrations in the volume, the one that most takes our own fancy is that of the Colorado mule-deer, or blacktail. It may be added that Dr. Elliot (p. 268) authenticates, by reference to an old sporting work, the statement (recently discredited by an American writer) that caribou formerly crossed from Newfoundland to the mainland on the ice.

The second of the two volumes is written on somewhat more technical lines than the first, the writers giving full lists, with the scientific names, not only of the species, but likewise of the subspecies of the salmon group. The first section of the book, by the author whose name is mentioned with the title, is exclusively devoted to the true salmon, which is common to both sides of the Atlantic. Unhappily, from want of due protection, this noble fish has been practically exterminated from the rivers of the United States, and, in the author's opinion, it would take ten years to fully restock them. On the other hand, "the British Possessions in North America undoubtedly afford the greatest field for the salmon angler of the future in any part of the globe." As Mr. Sage is a practical and observant fisherman of many years' standing, his remarks on the vexed question whether salmon feed while in fresh water are deserving of attention. His opinion is that they do, and his explanation of the fact that they are so seldom caught, even in the sea, with food in their stomachs is that they are in the habit of disgorging when threatened by danger. Several instances are cited of salmon seizing objects of considerable size with the apparent intention of swallowing them.

The ugly though valuable Pacific salmon of the genus Ogmorhinus, which often occur in such myriads in Alaskan waters and afford almost the whole of the world's supply of tinned salmon, are described by Messrs. Townsend and Smith, by whom five species are

recognised. Pacific salmon received the attention of fish-breeders at a comparatively early date; and, on account of extensive fishing and the pollution of many of the rivers, it is mainly owing to artificial propagation that the supply of these fish is maintained on the western sea-board of the United States.

The description of the numerous forms of trout and charr met with in the fresh waters of North America falls to the lot of Mr. W. C. Harris, and constitutes (inclusive of the angling notes) more than half the contents of the volume. The author divides these fishes into salmon-trout (commonly called brook-trout in America) and charr-trout. That all the latter are specifically, if not generically, distinct from the true salmon there can be no doubt, although it has yet to be proved that this is the case with the members of the former group. On this point, however, the author is silent, although he admits the extreme difficulty of classifying these fishes in a satisfactory manner.

"The most prominent external marking by which the salmon-trouts and charrs may be distinguished apart," writes the author, "is the presence of red or crimson spots on the body, the only exceptions being the great lake trout, with greyish markings, and the Arctic trout (*Salvelinus arcturus*), upon which no reddish spots have been observed."

It was owing to the absence of these red markings that the great lake trout, which now typifies the genus Cristivomer, was formerly regarded as a true trout instead of a charr.

In addition to being a practical guide which should be in the hands of every angler in American and Canadian waters, this excellent little volume is a valuable manual of North American Salmonidæ. R. L.

GAS ANALYSIS.

Methods of Gas Analysis. By Dr. Walther Hempel. Translated from the third German edition and considerably enlarged by L. M. Dennis. Pp. xix + 490. (London: Macmillan and Co., Ltd., 1902.) Price 10*s.* net.

THE value of this well-known handbook on gas analysis has been increased by additions both by the author and translator, so much so that those who already possess a copy of the first English edition will probably consider it necessary to obtain also the present one. The original work was practically restricted to a description of operations which could be carried out with the apparatus devised by the author, and this character is still retained. The slight incompleteness thus entailed is more than compensated for by the extremely practical nature of the instructions; every process described has been thoroughly tested and will work. The author has found it advisable to abandon the division into technical and exact gas analysis because, as he states in the preface, apparatus originally intended for technical purposes may advantageously be employed for many purely scientific investigations, and, on the other hand, technical analyses must often satisfy the most exacting conditions as to accuracy. The chief additions to the first edition comprise new methods for exact gas analysis and for the determination of combustible gases, the separation of argon from the atmosphere, improved methods for the determination of carbon monoxide in gas mixtures, the analysis of acetylene gas, the examination of gases produced by living bacteria, the simultaneous determination of fluorine and carbon dioxide, the determination of the heating power of gases, the estimation of sulphur in organic bodies and of carbon in steel, and the analysis of the gases evolved in the electrolysis of chlorides and the manufacture of bleaching powder. The method originally adopted by the author for the exact analysis of gases, although accurate, was somewhat cumbersome to work and expensive to set up. By adopting the principle of a compensation tube, slightly modified from the suggestion of Pettersson, the apparatus assumes a very practical form, gaining in convenience and cost without loss of accuracy. The determination of the heating value of gas, a determination which is rapidly increasing in importance on account of the extended use of gas for heating and power purposes and in the Welsbach incandescent burners, has been usually carried out in calorimeters of the Junker type. These are costly, require considerable amounts of gas, and must be carried to the place where the gas is being used. In the ingenious apparatus described by Prof. Hempel, a heating value can be determined on two litres, so that samples of gas can be brought from a distance in metallic receivers and examined in the laboratory.

In the analysis of combustible gases, it is shown by the translator that a modified Coquillion pipette, in which the combustion is carried out by an electrically heated platinum spiral, may in many cases advantageously replace the usual explosion method. The error due to the partial combustion of the nitrogen is avoided, and owing to the use of oxygen instead of air much larger quantities of gases can be burned with a corresponding gain in accuracy, numerous test analyses being given in proof of this point. The only suggestion which can be made as to additions to this chapter is an investigation as to the possible errors introduced into indirect explosion analyses by the deviations of the various gases from Boyle's law. According to Prof. Leduc, the errors from this cause may amount in special cases to as much as 3 per cent. when the gases are measured at constant volume. In the determination of carbon monoxide, a large amount of space, some twelve pages, is devoted to a description of the hæmoglobin method, whilst the method of C. de la Harpe and Reverdin, in which the monoxide is burnt by contact with iodine pentoxide, is dismissed with a short mention, although this method has been shown by Nicloux, Gautier and others to be at least as sensitive as the most refined modification of the blood reaction, and is also applicable to coal gas. As it seems probable that this method will supersede the doubtful cuprous chloride method, it would appear to have been worthy of a more detailed examination. In this case, as in others in which criticism might be offered, the author has preferred to give prominence only to those methods with which he has had personal experience. The work as a whole is a most valuable addition to the very limited number of works dealing with the handling and analysis of gases.

G. N. H.

THURSDAY, NOVEMBER 13, 1902.

THE BUTTERFLIES OF THE BORDERLAND BETWEEN NORTH AND SOUTH AMERICA.

Biologia Centrali-Americana. Insecta—Lepidoptera—Rhopalocera. Vols. i. and ii., 1879-1901. Pp. xlvi + 487 + 782. By Frederick Ducane Godman, F.R.S., and the late Osbert Salvin, F.R.S.

WE often hear, and are unfortunately compelled to admit, that the claims of learning are far too much neglected in our country, and that the wealth which is accumulated so much faster than in past times is but rarely under the control of men inspired as were the "pious founders and benefactors" of old. With humiliation and some perplexity we are forced to recognise that in younger lands the ancient spirit is as strong as it has ever been in history. Modern conditions have nothing to do with the indifference to learning exhibited by the average wealthy Englishman; for wealth is brought together under the newest of new conditions in the countries where it is lavishly spent in establishing and maintaining the centres of learning. And this is not only true of the most recent of Colonial and American universities. The older American universities date far back into colonial times. The life of Harvard as a university of an independent Power is even now shorter than its life in a British Colony; and yet Harvard, Yale and the other older American universities yearly receive benefactions for which Oxford and Cambridge look in vain. The needs of both Oxford and Cambridge are widely known in the country, as well as the serious lack in efficiency which both of them suffer for want of an assistance which on the other side of the Atlantic would be freely given. The difference in spirit seems to lie in a glorious "fashion" formerly dominant and powerful, but at present weak and enfeebled, in this country while it reigns supreme elsewhere. Such an interpretation is hopeful; for fashions may, and often do, revive, and even surpass, their former influence. All honour to those who in these latter days have helped on the good work in our land. Among these noble efforts on behalf of learning a prominent place will always be assigned to the munificence which has placed the investigation of the biology of Central America to the credit of British science.

The great work of which an important section forms the subject of the present article is now drawing to its close. It is, therefore, not inappropriate to say something of the biogeographical area of which the plants and animals are described in this vast monograph, or rather series of monographs, and to attempt to ascertain the reasons which induced F. D. Godman and the late Osbert Salvin to make the choice of their life-work.

However they may be divided and named, the life-bearing land-masses of the world are essentially arranged as an incomplete ring girdling the Arctic Ocean and sending three great extensions towards the south. P. L. Sclater's original classification of the zoological regions of the south, which has never been equalled by any of the later suggestions and would-be improvements, divides the northern ring into two regions, an Old-World segment and a New. It is admitted that this division is chiefly adopted for the sake of convenience and not because of any great difference between these two sections. The faunas of the three southern extensions differ widely from each other and also from those of the Holarctic belt. Interest is therefore concentrated on the point of junction between each southern extension and the northern ring, which more or less directly connects it with the two other extensions. The Ethiopian land-mass is cut off from the belt by a vast desert area. The most peculiar and interesting southern parts of the Indo-Australian mass are cut off by sea, the nearer less peculiar part by the most mighty mountain range in the world. There remains the Neotropical extension, in certain groups the most peculiar of the three, in species probably the richest, and, unlike the others, freely connected with the northern belt, the desert barrier penetrated by continuous north-and-south-running mountain ranges. Free continuity at no very distant period is in this case also proved by the reappearance of characteristic northern genera on the temperate southern Neotropical mountain ranges, such forms being wanting from the corresponding Ethiopian mountains. Furthermore, the east and west ranges of the Old-World part of the belt form barriers against which many plants were driven and exterminated by the advancing cold of the Glacial period, while in the New World the same species were able to escape southwards and return when the period came to an end.

From these considerations it is obvious that the point of junction between a south-extending land-mass, as peculiar as any of the three and far more freely continuous with the north than any other, is the most interesting and critical region in the world, and one which was bound to throw most light upon the problems of distribution. The vast importance of the thorough working out of this transition area Godman and Salvin had the genius to seize upon, as the result of their first visits, singly or together, in 1857-8, 1859-60, 1861-3—early days, when the "Origin" had only just appeared and the problems of distribution were first beginning to be attacked. So successful was the investigation, and carried on with such energy, enterprise and munificence, that this area, then obscure and little studied, has become probably better known than any other part of the world which can in any way compare with it in richness. The collections have been worked out by the most distinguished specialists, the descriptions published in the "Biologia," and with splendid generosity the whole material, labelled and complete, has been handed over to the nation, so that for all time the British Museum will be the one place in which the biology of Central America must be studied. Whatever may be true of the political sphere, the Monroe Doctrine of learning has been infringed on so magnificent a scale that any attempt at repair is hopeless, and our American friends will probably find their revenge by annexing biological territory in the Old World.

The completion of the two volumes on the Lepidoptera Rhopalocera of Central America is of especially deep interest. Here, as in the volumes on the bird fauna, we have the labour of the editors themselves, working together as more than brothers until the pathetic death of Osbert Salvin, on June 1, 1898, left the most obscure and difficult

part of this great monograph still unfinished. Three more years were required before the work was completed by F. D. Godman, who speaks of the large amount of help rendered him by the skill and energy of G. C. Champion, and the value of Dr. Holland's excellent book, which would have been a still greater assistance had it become available at an earlier date.

The immense development of the Central American Hesperiidæ, that difficult group which so long delayed the completion of the work, will be appreciated when the number of species, upwards of 550, is compared with the 178 of the New-World segment of the northern belt and the 66 of the Old-World segment. The study of the Pamphilinæ was a special cause of delay, and not only here, but in the whole family, an examination of the male genitalia, requiring the preparation of immense numbers of dissections, was found to be necessary.

"In Thanaos several of the species are absolutely inseparable by external peculiarities, but markedly different in their genital structure."

Such cases are remarkable and interesting, and range with those in which the males, as in many Enploeinæ, have not hitherto been separated except by the wide difference in secondary sexual characters, viz. the conspicuous "brand" on the wings. That species should be separable only by the characters directly or indirectly associated with the reproductive system of a single sex, while these sole differentiating criteria are strongly marked and evident, suggests the possibility of sexual dimorphism, rather than specific distinction, as an interpretation. Carefully conducted breeding experiments upon a few well-chosen examples would be well worth a trial, and would speedily decide beyond the possibility of doubt as to the interpretation of an immense mass of interesting facts of which the discovery is recorded in this monumental work.

Turning to the bearing of this section of the "Biologia" upon the broad principles of geographical distribution—one of the most important aspects of the whole work—it becomes necessary first to define precisely the extent and limits of the term Central America as employed by the editors. The area will be best understood by the enumeration of the following eight component districts:—North Mexico, South Mexico, British Honduras, Guatemala, Honduras, Nicaragua, Costa Rica and Panama. An excellent account is given of the physical geography of each of these divisions, into which, for the sake of convenience, the editors have separated the whole of their area. They find that the butterfly fauna, which includes many specially modified forms, is mainly a northern prolongation of the tropical South American, and extends to Mazatlan on the Pacific side and to a little beyond Ciudad Victoria in Tamaulipas on the Atlantic, although some purely tropical genera (Eutresis, Scada, Hetæra, Ithomeis, &c.) do not extend north of Nicaragua, Costa Rica or Panama. The Atlantic slope to as far south as Costa Rica has a more abundant rainfall, a more luxuriant vegetation and an immensely richer butterfly fauna than the Pacific, the difference being especially marked in Ithomiinæ, Erycinidæ, Thecla, Papilio, &c.

While the southern forms extend northwards over the coast areas, the Holarctic fauna presses southwards along the high central plateau into Mexico and to some extent even to Guatemala, where the northern genera Argynnis, Vanessa, Limentis and Grapta are met with, and various northern species of Colias occur. On the higher levels, no strictly Alpine forms are found, the insects above timber-line being mostly stragglers from below, while the highest forests are peopled, as in corresponding Andean localities, with species of such genera as Euptychia, Archonias, Catasticta, Pereute, Enantia, &c.

From the account given above, it is clear that the boundary between the northern belt and southern extension takes, roughly, the form of an attenuated U with its concavity directed toward the north. It has already been stated that no two regional faunas in the world are more unlike than the Holarctic and Neotropical. Their extraordinary differences can only be explained by geographical separation for an immense period. At length occurred that "psychological moment" in the organic history of the world when the boundaries fused together and the two contrasted faunas were geographically free to contend and to intermix. The insight of Godman and Salvin led them to investigate the one tract of the land surface of the globe which tells us most of the results of such a struggle. The main conclusion which is impressed by the vast array of facts in the "Biologia" is that stated by Darwin in the "Origin," viz., the predominance of the organic over the inorganic environment of living beings. By the "long results of time," in other words natural selection operating for a vast period, the northern fauna as a whole has been adapted to one environment and the southern fauna to another; and when the two are at length free to invade and to intermix, very little invasion and intermixture occurs. Each fauna is "an army of all arms," as Rolleston used to express it, strong enough in its own territory to repel the attacks of the other. The metaphor is an exceedingly good one, in that it emphasises the truth that each species of the whole fauna (and flora) is not only adapted to its inorganic environment, but also to countless other species of the fauna and flora of the same region. The U-like shape of the boundary line between the two regions expresses the fact that the northern forms gain advantage in the cooler higher ground, the southern in the hotter low-lying coast areas. The occurrence of northern genera on high ground towards the south of South America can best be explained by oscillations of level and changes of climate along the north-and-south-running mountain ranges, which have given northern forms an advantage over the southern and enabled bands of immigrants to press southwards until they reached a latitude to which they were permanently better adapted than the Neotropical fauna. Further changes of level and climate would then rapidly ensure the extinction of such species in tropical latitudes, so that the southward-extending bay of the U-formed boundary in the north and the colony of mountain forms cut off in the south remain as the only evidence of invasion.

The impression made upon the north by invaders from the south is doubtless far stronger, chiefly because the northern fauna being so much poorer the successful invaders make up a higher proportion of the whole. One marked result of successful invasion is certainly seen in the 178 species of Nearctic Hesperiidæ as against the

66 Palæarctic, the effect being doubtless mainly due to that exceptionally strong power of flight to which the authors attributed the unusually wide distribution of butterflies belonging to this family. Other still more interesting intruders are the great Danaine butterflies, of which *Anosia plexippus*, the "Monarch," is the best known and the widest ranging, inasmuch as it extends far into Canada. The peculiar interest of these settlers lies in the fact that certain species of the Holarctic fauna have been profoundly modified into mimicry of them, thus proving beyond the possibility of doubt that the invasion is no new thing—like the spread of the great Danaine *plexippus* into the Philippines, the Fijis, Australia, Hong Kong, &c.

The whole of the vast mass of material in these and the great series of companion memoirs is a remarkable testimony to the insight of P. L. Sclater in drawing the outlines of his regions, of Darwin in laying down the principles of geographical distribution in the "Origin," and of Wallace in his masterly development of the subject in his great works on the geographical distribution of animals. These principles have been tested by an appeal to the facts collected with consummate skill and care from the most critical area in the world, and assuredly they have not been found wanting.

The work is printed and brought out in the same beautiful and costly style as the rest of the series. It contains 112 plates, with more than 2000 admirably executed hand-coloured figures representing 1250 species, and nearly 550 uncoloured figures of the structural parts of butterflies.

The total number of species of Rhopalocera recognised in Central America as here defined is 1805, as against 642 in the New-World and 716 in the Old-World segment of the Holarctic belt. Of these 1805, 360 (almost exactly one-fifth) are described as new. A valuable table of genera shows distinctly and at a glance the relative numbers of the species in each of the eight districts of Central America, in South America, in North America and in the West Indies. The extraordinary poverty of the fauna of the latter is well brought out by this comparison.

The classification adopted is mainly that of H. W. Bates in his paper on the insect fauna of the Amazon Valley (*Journal of Entomology*, ii. pp. 175–185, 1864). The Libytheidæ, instead of being included in the Erycinidæ, are kept as a separate family, represented in the area under consideration by a single species. One slight criticism may be suggested; the monograph begins with the most specialised subfamily the Danainæ, but within the subfamily itself the more specialised group the Ithomiina follows, instead of precedes, the less specialised Danaina.

This vast undertaking has required the cooperation of some of the best living collectors of insects. In addition to the visits of the editors, Mr. G. C. Champion, Mr. H. H. Smith and many others have remained in Central America for long periods of time collecting material for the "Biologia." Great collections, such as those of H. W. Bates and Herbert Druce, have been acquired as a whole and added to the mass of material, which was steadily accumulating for forty years. Wherever Central American specimens could be acquired or borrowed, they have been studied for the purpose of this great work; the single exception was due to the impossibility of receiving the loan of Plötz's quoted but unpublished figures. It is unnecessary to say anything further of a difficulty thus gratuitously thrown in the way of a memorable advance in zoological science, a great gift, not restricted to any single nation, but conferred upon the learning of the world.

The thorough treatment of the more obscure Central American groups and genera is such as to render the work absolutely necessary for the study of the related species in other parts of the world.

It would be inappropriate to discuss the details of this great monograph at any length on the present occasion, but all naturalists should gain a knowledge of the general results, in part briefly discussed in this article, which are lucidly set forth in the introductory chapter. And every naturalist, before he reaches the end of the record of results and conclusions, will feel how deep is the debt that he owes to the research and munificence which have led to so notable a widening of the boundaries of knowledge.

E. B. P.

PRINCIPLES OF DYNAMICS.

Sur les Principes de la Mécanique Rationelle. Par C. de Freycinet, de l'Institut. Pp. viii + 167. (Paris: Gauthier-Villars, 1902.) Price fr. 4.

M. DE FREYCINET first became known to the world as the author of a treatise on dynamics of some bulk and repute, which was published in 1858, and the essay before us shows that at the end of his long and distinguished career of active public life his interest in the subject remains unabated. Referring to his publications during the intervening period, we find two relating to dynamics. In 1887, he communicated to the Academy of Sciences (*Comptes rendus*, cv., pp. 903–910) a note containing the rather interesting suggestion that the term "dynamical capacity" should be adopted in the place of the term "density" as derived from dynamical considerations, on the analogy of calorific capacity; also some proposals about units which were not likely to meet with acceptance. He proposed a standard unit of length derived from the value of gravity at Paris, recommending it by the remark that the length of a pendulum can be measured more conveniently than that of a meridian of the earth. In 1896, he published his essays on the philosophy of the sciences, containing some chapters on mechanics.

The book before us gives the impression of not being up to date, and repetitions from the author's former works which we find in it afford some explanation of this. He does not appear to be well acquainted with the modern literature of the subject. One might expect to find some sign of the influence of Mach, but there is none. The framework of the essay is a constructive sketch of the subject, which cannot be regarded as of much value. It is chiefly interesting on account of the satisfactory tone of protest against *a priori* judgments with regard to the principles of dynamics and on account of some attempts which are made to amend the phraseology of the subject, among which "dynamical capacity" figures prominently. It is disfigured by some inaccuracies and obscurities.

It seems, for example, hopeless to attempt to understand what is meant (p. 86) by the fixity of the sun relative to the earth, which we are told would result from the attraction between the sun and the earth losing its reciprocal character. And the explanation (p. 134) of the mechanical equivalent of heat by the example of the coal consumption required for working an elevating machine, as compared with that required for raising the temperature of water, is not a happy one, even with the addition of a parenthetical reference to unavoidable losses.

The author thinks that there has been too great a tendency among the writers of treatises on dynamics to deal with the subject as a merely abstract science, with but little reference to the basis supplied by the observed motions of actual bodies. But he omits to notice what has perhaps been the most unsatisfactory feature of such treatises, namely, their frequent neglect to deal with the question of the establishment of a base relative to which to measure motions for the purpose of the laws of motion, obscurity thus arising with regard to a fundamental point. Indeed, the book before us affords as good examples as could be found of obscurity due to an attempt to construct statements dealing with the motion of actual bodies without clear specification of the base employed.

In the treatment of dynamics as an abstract science, a base may be assumed at the outset, without any reference to the question whether or how such a thing can actually be identified in nature; but so long as this question is postponed, any comparisons with actual motions are apt to be inaccurate or puzzling. Newton's adoption of the postulate of an "absolute motion," as he called it, stands in the forefront of his statement of the theory. He expounded what he meant by absolute motion sufficiently for his purpose, and for a time his followers were content to accept his statement. But a stumbling block was found in the use of the word "absolute," and this word fell into disuse without any more appropriate terminology taking its place, and thereupon the point in question, instead of taking the first place in any statement of the theory, fell so much into the background as to be in danger of being overlooked altogether. The fact remains that the so-called laws of motion apply only to motions relative to a suitably chosen base, one which is probably connected with other phenomena of physics, but may naturally, and must in the first instance, be regarded merely as a creature of the theory, with no right to a title involving such words as "absolute" or "fixed."

THE DISCOVERY OF JAPAN.

Geschichte des Christentums in Japan. Von Pfarrer Hans Haas. I. Erste Einführung des Christentums in Japan durch Franz Xavier. (Tokyo, 1902.)

IN this large octavo volume of 300 pages, admirably printed at the Rikkyo Gakuin Press, we have the first instalment of what promises to be as full and accurate an account of the discovery of Japan and of the rise, course and downfall of Christianity in that country during the sixteenth and following centuries as the accessible materials render possible. A distinguishing feature is the extent to which native sources of information have been consulted, and though these are neither ample nor very trustworthy, their use lends an interest and an authority to the work which are lacking to the results of previous efforts to present the subject to European readers.

The first notice of Japan was brought to the west by Ser Marco Polo. In a passage pregnant with consequences to East and West, he, or his literary friend to his dictation, writes:—

"Zipangu (Jihpênkwo *anglicé* Jippunkwo, *i.e.* Orient Land) is an island in the high seas lying eastward [of China] . . . . it is of great extent . . . . the inhabitants . . . . are idolaters and independent. And I can tell you that the quantity of gold they possess is inexhaustible . . . . the exportation is forbidden . . . . hence they have an immeasurable surplus of gold."

It is not too much to say that the Venetian traveller's words, scouted in his own day, led to the discovery of America, and to the discovery and temporary Christianisation of Japan. Marco Polo's travels were printed in 1477. What he wrote about "Zipangu" came to the ears of Columbus through Toscanelli, and in 1492 the great navigator sailed westwards to discover the great eastern island about which his contemporaries thought him "extravagant and clean possessed." It was his Ophir, and such he held it to be to the end of his days. Yet the wealth of Japan was a mere fable—even in 1887 its production of gold did not surpass some 500 kilos. It was thus a delusion that led to the discovery of America, or rather prepared the way for that discovery of the Pacific Ocean which proved America not to be a portion of Eastern Asia.

For the discovery of Japan the world had to wait another half-century. It was not the result of design, but indirectly of the division of the undiscovered world by Pope Alexander VI., in 1493, between Spain and Portugal, in return for their armed support of the Roman system—probably the biggest deal the world has seen—and directly of the shipwreck, in 1543, of a Chinese piratical junk having three Portuguese deserters on board on the shores of the island of Tanegashima, lying south of the southernmost point of the island empire. As early as 1508, as Mr. Donald Ferguson has recently shown in his interesting "Letters from Portuguese Captives in Canton, 1534-6," Lopes de Sequeira had been ordered to inquire after the Chijns (Chinese), and in 1517 definite commercial relations were established with Canton. Galvano and Xavier both mention the discovery, but the various accounts, including the Japanese, differ as to time and locality. Nevertheless, it is pretty certain that it took place as above stated, and to this day in Japan "Tanegashima" means a gun or pistol.

But in his famous Peregrinação, Fernão Mendez Pinto lays claim to the discovery as his own—through the mischance also of the Chinese junk, on which he was taking a passage from "Sanchan" to "Lailo" with two companions, being driven by stress of weather to seek shelter off the same island of Tanegashima. Pinto was dubbed by Cervantes the Prince of Braggarts, and our own Congreve uses him as a type wherewith to compare a "liar of the first magnitude." A letter of his own and others of his brethren of the Society of Jesus in which we should expect to find some reference to this exploit

do not mention it, and I agree with Herr Haas that the story is a mere invention.

Of the arrival at Malacca some time in 1547 and of the subsequent conversion by Xavier of three Japanese there can be no doubt, however much we may distrust Pinto's account of his share in bringing about their visit. The chief of the three, Anjiro (Hachiro ?) induced Xavier himself to go to Japan, and in 1549 the great apostle of the east landed at Kagoshima, famous some three centuries later for its stout resistance to an English squadron.

Of Xavier's labours I can say little here. He remained two years and some months in Japan, founded three churches and baptized some 800 converts. Herr Haas speaks highly of his labours. But he seems to have been satisfied with mere external observances, and his ignorance of the language must have reduced his dogmatic teaching to its least expression. What would be interesting and instructive to know would be what the Japanese, especially the Buddhists and Confucianist scholars, thought of his doctrines. No hint has come down to us—perhaps they took no thought of a strange religion that seemed of no great importance. The chapters on the social and political conditions of Japan in the sixteenth century are interesting—particularly the account they give of Buddhism and Confucianism, both in themselves and as a setting to Xavier's apostolate.

Herr Haas's style is not unattractive, and in the eulogy of Xavier rises into eloquence. But—to an Englishman at least—many of the sentences, often occupying half a page or more, are both tedious and obscure. A portrait of Xavier taken from an old print is prefixed, which, however, bears little resemblance to that contained in Dr. Murray's "Japan."

F. V. D.

CHEMICAL PHILOSOPHY.

Le Mixte et la Combinaison Chimique: Essai sur l'Évolution d'une Idée. By E. Duhem. Pp. 207. (Paris, 1902.) Price fr. 3.50.

FROM the earliest times there have existed two opposed views of the constitution of homogeneous mixtures. According to one view, the mixture was in reality as in appearance homogeneous. The elements composing it disappeared as such and were replaced by an entirely new thing, the mixture, from which, however, by appropriate treatment the original elements might be regenerated. According to the other view, the homogeneity was only apparent, and due to the feebleness of our senses. Each element consisted ultimately of atoms, which in the mixture retained their individual character, being mingled, but in no sense fused.

Prof. Duhem in the present essay, which originally appeared in the *Revue de Philosophie*, follows the fortunes and discusses the scientific evolution of these ideas from the time of Bacon and Descartes to the present day. In a series of interesting chapters, he shows the adaptation of chemical theory to facts as they accumulated, tracing the development of the notions of element, equivalent, substitution, type, valence, isomerism. It is, however, to the last chapters that chemists will probably turn with the greatest interest. In these the author gives a critique of the atomic theory and an account of chemical mechanics. His point of view may best be given by quotation.

The great achievement of atomic theory is the simple interpretation of the law of multiple proportions. But, the author asks, is the victory decisive? Who can say that this is the only possible explanation?

"When we see with what simplicity and clearness all the principles of modern chemistry may be systematically expounded, though the name and notion of atom are alike absent, and what difficulties and contradictions arise when it is desired to interpret these principles according to the doctrines of the atomists, we cannot help thinking that the sole success of the atomic theory is only an apparent victory and one without a future, that the theory does not show us the true objective basis of the law of multiple proportions, that this basis still remains to be discovered, and finally, in a word, that the evidence of modern chemistry is not in favour of the Epicurean doctrine."

In a foot-note, the author draws attention to the circumstance that what is here said of the law of multiple proportions and its interpretation by atomic hypotheses may be repeated word for word of the crystallographic law of rational indices and its interpretation either by the integrant molecules of Hauy or the space-nets of Bravais.

With regard to the general aspect of physics and chemistry to-day, the author says:—

"Physical science is not a metaphysic. It has no intention to penetrate beyond our perceptions in order to grasp the essence and ultimate nature of the objects of these perceptions. Its end is to construct by means of signs borrowed from the science of numbers and from geometry a symbolic representation of what our senses, aided by instruments, bring to our knowledge. Once constructed, this representation lends itself to reasoning more simply, rapidly and certainly than the purely experimental data for which it was substituted. By this artifice, physics assumes a breadth and precision which it could never have attained without clothing itself in this schematic garment which we call theoretical or mathematical physics. To each element which logical analysis discovers in any physical concept there now corresponds, not a metaphysical reality, but a geometrical or algebraic character of the symbol which is substituted for the concept. For the notion of a chemical substance, for example, there is substituted a chemical formula; the idea of the analogy of two chemical systems is expressed by a series of equalities between the indices which affect certain letters; the idea of derivation by substitution is represented by means of certain lines or 'bonds'; and the dissymmetry of a geometrical figure serves to represent a substance possessed of optical activity."

We can thoroughly recommend the book for the thoughtful consideration of those interested in chemical philosophy.

OUR BOOK SHELF.

Die Internationalen absoluten Masse insbesondere die elektrischen Masse. By Dr. A. von Waltenhofen. Third edition. Pp. xi + 306. (Brunswick: Friedrich Vieweg und Sohn, 1902.) Price 8 marks.

IN preparing the third edition of this book, the author has, by introducing an amount of new matter, nearly equal to the whole of the second edition, sought to make the work, not only a complete study of the international system of units and measurement, and in particular of the electrical units, but also an introduction to the study of electrical

engineering (Elektrotechnik). In a work dealing with such a subject, we should have thought the publishers would not have departed from the very sensible plan, adopted in practically all good German scientific books, of printing in the ordinary Roman type instead of in the German script. We can safely assert that the adoption of the German character will very considerably reduce the number of foreign readers.

The book is divided into two parts, the first containing chapters on the mechanical, magnetic, electrostatic and electromagnetic units, and a comparison of these two latter systems.

The second part, taking up three-quarters of the book, is entitled "Additions and Explanations" (Zusätse und Erläuterungen), and consists of a somewhat curious collection of all kinds of information and numerical examples, and we are afraid that the reader who uses the book as an introduction to the study of electrical engineering will not profit very much thereby. We think, in fact, that the two objects of the book are incompatible, as it is hardly reasonable to expect a person just beginning to study electrotechnics to grasp such conceptions as the relations of the electromagnetic and electrostatic systems of electrical units, and so forth, or to go from chapter ii. of the second part, on the calculation of dynamos and considerations of the thickness of the insulation on double cotton-covered wires, &c., to chapter iii., introducing, without a word of warning, highly involved considerations of potential theory with differential equations half a page long.

The book will be mainly useful to teachers in technical colleges and schools, who are often called upon for the satisfaction of inquiring students to work out a formula from first principles, a subject with which the practical man has neither the time nor the inclination to bother. Such a teacher would find it useful to have this book by him, and the many references and footnotes given would be additionally helpful in such cases.

In fact, the book appears to us like a collection of notes of theoretical considerations and blackboard examples acquired by a lecturer to assist him in his lectures, and as such will no doubt have its sphere of usefulness.

If we may permit ourselves one more remark, in paragraph 92, on "hydroelectric chains," examples are worked out at length on the calculation of electromotive force according to the old "Thomson" law (equivalence of heat of reaction and electrical current work), and the only warning given that this assumption is both fundamentally wrong and in many cases leads to totally false results is given in a footnote. In a work on "absolute" units, this should hardly occur. The book is indexed very well, which is an additional advantage from the above-mentioned point of view. C. C. G.

Index-tabellen zum anthropometrischen Gebrauche. By Carl M. Fürst. (Jena: Gustav Fischer, 1902.) Price 5 marks.

IN the preparation of their great work "Anthropologia Suecica, Beiträge zur Anthropologie der Schweden," Drs. Gustaf Retzius and Carl M. Fürst had to deal with a vast mass of figures. It is the custom of physical anthropologists, not merely to publish their measurements, but also to give the ratio of a given measurement to another, and this is termed an "index"; for example, the ratio of the breadth of the head to its length is called the cephalic index, and is obtained by multiplying the breadth by one hundred and dividing the product by the length. The calculating of a large number of indices is undeniably a very tedious process, and various devices have been employed to save the student this clerical labour. Certain mechanical and other devices have been invented, but these have never proved satisfactory and are not employed by serious workers. The most accurate and practical rapid method of determining an index is by means of tables which have been carefully computed. It is evident that such tables once constructed and published would materially lighten the labour of those who do this kind of work.

The first tables of this nature were published by Prof. Welcker in the *Archiv für Anthropologie* in 1868. They were calculated only for the cranial index, and even so were not of sufficient range. In 1879, Prof. Flower published some very useful and on the whole accurate tables in his well-known Osteological Catalogue of the Royal College of Surgeon's, London, Part i., Man. These were calculated for the various cranial indices which he employed in that valuable publication; though these tables have proved a great boon to workers, they are not sufficiently extensive to meet modern requirements. Of greater scope are the Broca's tables which were published by Bogdanow in the *Mittheil.* d. kaiserl. Gesells. d. Naturwiss. anth., eth. Abtheil. (Moscow, 1879.) These also had some clerical errors, and the size of the page rendered it somewhat unwieldy. This publication was very difficult to obtain, and as a matter of fact the tables were not generally used by anthropologists.

Now all this is changed, as Dr. Fürst has published his extensive tables in a convenient form and at a low price, and has placed at the disposal of his colleagues, in twenty-nine tables, the result of the enormous labour of Fräulein Ellen Anderson-Gülich, who has made the requisite calculations.

Anthropologists will find in these tables practically all the indices they are likely to require, but there are certain indices which have not been carried sufficiently far to include some of the more extreme measurements that can be made on the living subject of non-European peoples; this will affect but few investigators, and that only rarely. Our hearty thanks are due to Dr. Fürst.

Jahrbuch der Chemie, 1901. Herausgegeben von Richard Meyer. (Brunswick: F. Vieweg und Sohn.) Price 15 marks.

THE Jahrbuch for 1901 is the eleventh of the series, and has for its object a review of the chemical work done during the year. Very few alterations are to be noted in comparison with the previous publications so far as arrangement and scope of the work are concerned. Several changes have, however, taken place on the editorial staff. In consequence of the death of Prof. Märcker, the chapters on agricultural chemistry, technology of the carbohydrates and brewing industries have been relegated respectively to Profs. Morgen, Herzfeld and Delbrück. Dr. W. Küster, of Tübingen, is now the editor of the section on physiological chemistry, and Prof. Doeltz, of Clausthal, of that on metallurgy.

The various authors appear to have given, on the whole, a satisfactory account of the research work carried out in their respective provinces, and the reader will obtain a good idea of what has been accomplished during the past year in both pure and applied chemistry. It seems doubtful, however, whether a compilation of this kind, in which nearly all the collaborators are of German nationality, gives the best possible account of the work of men of science in other countries. The greater part of the researches in pure chemistry carried out by English chemists is published in the *Transactions* of the Chemical Society. The editors of the various sections of the Jahrbuch apparently consider themselves in many cases capable of giving a clear and succinct account of these investigations by reference to the short notes in the *Proceedings* of the Society. It is unnecessary to point out the impossibility of such a mode of procedure being attended with any measure of success, and the practice must be strongly condemned.

It is to be hoped that, in future publications of the year book, greater care will be exercised in rendering an account of the work of English chemists. Its claims to

furnish a faithful review of the most important research work accomplished during the year can only be justified on that condition. H. M. D.

Observations Géologiques sur les Îles Volcaniques explorées par l'Expédition du "Beagle," et Notes sur la Géologie de l'Australie et du Cap de Bonne Esperance. Par Charles Darwin. Traduit de l'Anglais sur la Troisième Edition par A. F. Renard, Professor à l'Université de Gand. Pp. xxii+218; 14 figures, one plate. (Paris: Schleicher Frères, 1902.)

THIS volume is the first part of a French translation by Prof. Renard of the geological portion of the "Journal of a Naturalist," which book, as he remarks in his preface, preceded the "Origin of Species" by fifteen years and shows how surely Darwin had laid in his own mind the foundations for the development of that classic work. We should, indeed, have said that the geological observations proved at what a cost to this science the new birth of biology was obtained did we not remember that the idea of evolution has not only reanimated palæontology, but also has led to a new way of regarding even the inorganic world. Time has not deprived of their value those sections of "Geological Observations" which deal with St. Paul's Rocks, with the fluxional and spherulitic structures in the obsidians of Ascension Island, and with other volcanic islands and the order of eruptive rocks. They, indeed the whole work, can still teach geologists, and not only those who are beginners, the right methods in both observation in the field and the inductive treatment of facts; in a word, how to grapple with new problems. Prof. Renard's intimate knowledge, not only of geology, but also of the English language, so fits him for the work of translation that it is almost needless to say this has been admirably done, and he has added to the value of the volume by including in it the introductory essay which was contributed by Prof. Judd to the volume of the Minerva Library of Famous Books containing Darwin's geological works.

Galvanic Batteries: their Theory, Construction and Use. By S. R. Bottone. Pp. xvi + 376. (London: Whittaker and Co., 1902.) Price 5*s.*

ALTHOUGH the subtitle of this book indicates a comprehensive aim, it is only the construction of primary batteries that receives at all full treatment. In this respect the work is pretty thorough, since the author describes more than 200 different types of cell. The descriptions are short, but are supplemented in many instances by drawings, and should be sufficient to give any reader a clear idea of the essential features of the cell. Data as to the E.M.F., internal resistance and discharge are also given for a fair number of typical batteries. As a handy reference book to which one can turn for information of this sort, this volume should prove very useful, especially, perhaps, to the amateur or to the inventor who is anxious to see if amongst these 200 odd cells there is room for yet one more. From a scientific point of view, the work is disappointing; the tabulation of the different cells is not carried out upon any definite system of classification, so far as we can see, and the theoretical discussion in the first seventy pages is inadequate and unsatisfactory. It is hardly adequate, for example, only to describe the Grotthuss theory (as modified by Clausius) and to speak of this as the "accepted theory of to-day." Again, the fundamental conceptions do not appear to have been clearly grasped by the author, who seems to think that energy and force are the same, and that electricity is a form of energy and may be defined as "a mode of motion in the atoms of bodies." We should not comment upon these errors in a work which is more particularly of a practical character did not the author claim in his preface that "the theory of the battery has been carefully gone into." Should another edition be called for, we think Mr. Bottone would be well advised to omit the theoretical part altogether and confine himself to the careful tabulation of the cells; the information contained in the descriptive part must have needed considerable pains to collect and can hardly fail to prove useful.

The illustrations are, for the most part, clear; there are one or two minor errors, such, for example, as the misspelling of the names of Sir W. Thomson, Latimer Clark and Grotthuss, which we should like to see corrected. M. S.

The Elements of Agricultural Geology: a Scientific Aid to Practical Farming. By Primrose McConnell, B.Sc. Pp. x + 329. (London: Crosby Lockwood and Son, 1902.) Price 21*s.* net.

MR. PRIMROSE MCCONNELL is well known as a shrewd writer on practical farming and as one who has done a good deal to bring the facts of science within the reach of the farming community. The present work is on the fascinating subject of agricultural geology. It has evidently been written *con amore*, and we are told in the preface has occupied the author for many years. He treats first of the origin of soils, then follows a chapter on mineralogy, another on physiography and one on water supply. We then come to the most important section of the book, entitled "Formations and Farming," occupying about 110 pages. The volume closes with a section dealing with the evolution of the present breeds of horses, cattle, sheep and pigs.

The most valuable section, and the one containing most original matter, is that relating to formations and farming. We should much like to see this section greatly expanded and its very various subjects treated in full detail, and the whole accompanied by a good geological map of the United Kingdom, which the present volume, notwithstanding its high price, fails to supply. Such a work would be of standard value. Much of the rest of the volume has apparently been compiled from well-known text-books, references to which are freely given.

To the value of the central section we have already referred, but of the book generally we cannot speak so highly. The book has been loosely written, without much attention to scientific exactness, and hasty statements are from time to time made which require at least serious qualification.

The author views the soil as in every case the chief determining factor of agricultural results, whether relating to crops or animals, and a result is said to follow because the soil is Red Sandstone or Mountain Limestone. The considerable influence of varying climate in a country such as our own is seldom taken into account.

A Teacher's Manual of Geography to accompany Tarr and McMurry's Series of Geographies. By Charles McMurry, Ph.D. Pp. 107. (New York: The Macmillan Company, 1902.) Price 2*s.* 6*d.*

TO teach successfully it is not only necessary for a teacher to have a good knowledge of his subject, but he should also know how best to present its parts to his class, and be familiar, in the case of subjects like geography, with the use to which the common objects of the neighbourhood of the school can be put in rendering lessons clear and interesting. This little book abounds in helpful hints to teachers of geography; it explains how the best results are to be obtained from school excursions, and it should convince the reader that geography is something more than topography, and should be made a means of arousing interest in such subjects as the formation of soils, the cause of scenery, and other changes which are too often ignored in school courses of geography.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Refractivities of the Elements.

IN NATURE for October 16 I drew attention to the relation which exists between the refractivities of the inert gases of the atmosphere and that of hydrogen. Further comparison with the values obtained for other elements shows that the occurrence of simple ratios between the refractivities of allied elements is so frequent as to reduce greatly the possibility that they may be due to chance.

Thus, in the table previously published, there was a gap between krypton and xenon to be filled by an element the refractivity of which should be four times that of hydrogen. This condition is exactly fulfilled by mercury, the vapour of which is also monatomic. The refractivities of chlorine, bromine and iodine are almost exactly in the ratio of 2, 3, and 5, corresponding to those of argon, krypton and xenon; and it is remarkable that the latter trio occupy places in the periodic table which are adjacent to those of the former trio respectively. I cannot find that the value of the refractivity of fluorine has yet been directly determined; but, if there is any law connecting these figures, it should probably bear the same relation to that of chlorine which the refractivity of neon bears to that of argon, *i.e.* $\frac{1}{4}$. It should, therefore, be equal to $\frac{768}{4}$ = 0·192 (H = 0·139).

Again, making allowance for the density of sulphur vapour (96), the refractivity of sulphur is to that of oxygen as 2 is to 1. The following are the figures:—

Element.	Refractivity (Air=1.)	Refractivity (H=·139).	Ratio to H.	Error per cent.
Helium [1] ...	0·1238		$\frac{1}{4}$	−4·4
Neon [1]	0·2345		$\frac{1}{2}$	+0·9
Hydrogen [1] ...	0·4733		1	
Argon [1] ...	0·968		2	−2·2
Krypton [1] ...	1·450		3	−2
Mercury [2] ...	1·893	0·556	4	0
Xenon [1]	2·364		5	+0·1
			Ratios to Cl=2	
Chlorine [3] ...		0·768	2	
Bromine [4] ...		1·125	3	−2·4
Iodine [4] ...		1·920 Violet 2·050 Red	5	0
			(Ratio to O=1)	
Oxygen [3] ..		0·270	1	
Sulphur × 3 [2]		1·629	2	+0·6
Nitrogen [3] ...		0·297		
Phosphorus [2]		1·364		
Arsenic [2] ...		1·114		

The values for Hg, S, P and As were published by Le Roux in 1861 and do not appear to have been verified since. At least, no other determinations are published either by Dufet or by Landolt and Börnstein. Iodine shows anomalous dispersion, and the choice of the value 1·920, which represents the refractive index of the least refracted rays, is arbitrary.

The values for N, P and As do not fit into the scheme, and a redetermination of them would be interesting.

CLIVE CUTHBERTSON.

9 York Terrace, N.W., November 3.

[1] Ramsay and Travers, *Phil. Trans.*, cxcvii., A. 1901.
[2] Le Roux, *Ann. Ch. et de Ph.*, lxi., p. 385, 1861.
[3] Mascart, from Dufet, "Recueil des Données numériques," i., p. 75.
[4] Hurion, *Ann. de l'École Normale, sup.* (2e série), t. vi., p. 380, 1877.

Artificial Mineral Waters.

I THANK you for your kindly notice of my little book in your issue of October 16 (vol. lxvi. p. 602), and I am quite content to leave your reviewer's remarks concerning its blemishes to the judgment of your readers with the one exception of that dealing with the precautions for preventing the contamination of the carbonic acid gas with ammonia. If your reviewer will call to mind the fact that in the generating vessel there is a mixture with an alkaline reaction until the charge is exhausted, he will not consider it as so very astonishing that ammonia may pass into the gas holder. At all events, manufacturers of mineral waters have suffered too much in time past from the presence of gaseous impurities in the carbonic acid gas to permit them to allow the smallest trace of such impurities to contaminate the waters. The conditions of manufacture are such as not to warrant the expectation that either the alkali or the acid in the generator will suffice to hold back traces of either acid or alkaline gases.

WILLIAM KIRKBY.

I UNDERSTAND that Mr. Kirkby objects to the statement I made, in my recent review of his book on "The Evolution of Artificial Mineral Waters," to the effect that precautions to avoid the contamination of the carbonic acid gas with ammonia derived from such traces of ammonium salts as might exist in the sodium bicarbonate employed were unnecessary. In reference to this I would point out that sodium bicarbonate does not decompose ammonium salts under the conditions in question, and that any tendency to become converted into the normal carbonate owing to rise of temperature is effectually checked by the constant production of carbonic acid gas in the liquid in the generator. This is what I meant by saying that the acid used constitutes a sufficient precaution, and if Mr. Kirkby will try the experiment, as I have done, he will find that no trace of ammonia passes from the generating vessel. That manufacturers of foods and beverages should take every possible precaution to avoid the contamination of their products is, of course, highly desirable, but any precautions specially taken for the purpose of avoiding the presence of this particular impurity are, I still maintain, quite unnecessary.

THE REVIEWER.

Light-Therapeutics.

AS a constant reader of your valuable and interesting paper I shall esteem it a favour if any of your scientific correspondents can inform me what is the action of the red rays of light on the hair, and what authority is there for supposing that they have a beneficial effect on the scalp.

In what periodicals, &c., could I find reference to this question?

P. H. BAILY.

Leadenhall House, London, E.C., November 6.

Waste of Energy from a Moving Electron.

IN my last week's letter, I observe some corrections are required. Equation (11); the depth of the shell should be $vdt\,\{1-(u/v)\cos\theta\}$. Equation (13); insert the factor $(1-u^2/v^2)$ on the right side. Equation (14); divide the second term on the right by R.

OLIVER HEAVISIDE.

BRITISH ASSOCIATION GEOLOGICAL PHOTOGRAPHS.

PROBABLY no instrument—not including the bicycle—has more facilitated the labours of the geologist than the photographic camera, which has for some time past become almost as necessary a part of his outfit as the indispensable hammer. Professional and amateur workers alike carry it, and photographs of geological features do increasingly abound. This was already true in 1888, when the happy idea occurred to Mr. Osmund W. Jeffs of forming a public collection of geological photographs, which should be lodged in some central and readily accessible place. As he rightly pointed out, "photographic records of sections and other geological features . . . are not only invaluable aids to geological instruction, but serve also to preserve for future reference the details of many exposures of strata and other landscape features, which in course of time . . . are in danger of

becoming obliterated." At Mr. Jeffs's suggestion, a Committee of the British Association was appointed at the Bath meeting, charged with the duty of obtaining geological photographs, which were to be duly preserved, catalogued, dated and described. The Committee commenced its labours by inviting contributions from all British geologists, and its appeal met with a most generous response. Photographs at once began to flow in, and have continued to do so ever since, so that a vast mass of valuable material is now accumulated in the Museum of Geology, Jermyn Street, which was selected as the home of the collection.

The usefulness of the collection has now been largely increased by the action of the Committee in resolving to publish a selected number of its best photographs, and geologists are greatly indebted to the secretary of the Committee, Prof. W. W. Watts, for the admirable manner in which he has carried this resolution into effect. The success of his efforts is witnessed by the first issue, now before us. It comprises twenty-two photographs, contained in a neat portfolio case; each is accompanied by descriptive letterpress, the date when it was taken and the name of the photographer. The descriptions are terse and to the point, as might be expected when it is added that they are all contributed by well-known geologists; among others, we notice the names of Sir Archibald Geikie, Prof. Bonney, Mr. J. E. Marr and Prof. Watts himself. To show how thoughtfully even smaller matters have been attended to, we may point out that a duplicate copy of the letterpress is provided, printed on one side of the paper only and gummed on the other, so that when mounted each photograph may bear its own description secured to it. Further, in addition to the paper prints, which are platinotype and therefore permanent, there is another

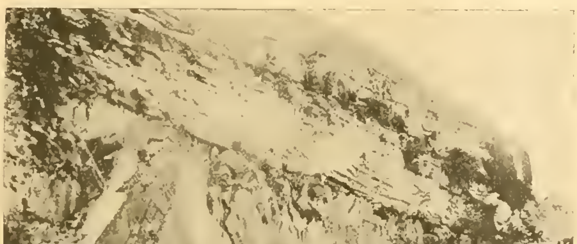


FIG. 1.—Carboniferous Limestone resting unconformably on Ludlow Slates; Arco Wood Quarry, west side of Ribblesdale, about four miles north of Settle, Yorkshire. Photographed by Prof. S. H. Reynolds, 1889. The horizontal beds at the base of the Mountain Limestone here rest unconformably on the upturned and denuded edges of the Ludlow Slates. The latter formed a plane of marine denudation which quickly subsided, causing the absence of mechanical sediments. The district furnishes evidence that many thousands of feet of Lower Palæozoic rock were denuded before the deposition of the Carboniferous strata. An inconstant conglomerate, a few feet in thickness, with pebbles of Lower Palæozoic rock in a calcareous matrix, is found in places, but it is absent in the section photographed. The Ludlow beds are seen dipping south at a very high angle. A marked bedding-plane is seen at the south (left) end of the photograph (above the initials S.H.R.). The more prominent planes visible in the photograph, traversing the slates, are cleavage planes, inclined to the north at an angle higher than that of the bedding. The straight face of the limestone is due to dominant joints. The cliff, from the base of the quarry to the sky line, is many scores of feet in height. JOHN E. MARR.

issue in the form of lantern slides, which should prove of great value in the lecture room.

Where all are excellent it is difficult to choose, and the accompanying photographs, which, with the kind permission of their photographers, we select for reproduction on a reduced scale, are no better or worse than the remainder of the series.

The issue is the first of three, the second of which may be expected to appear before the end of the current

FIG. 2.—Widened joints ("grikes") and rain-gullies in Carboniferous Limestone; Hampsfell, near Grange, Lancashire. Photographed by Mr. Godfrey Bingley. The top of Hampsfell, near Grange, presents a weird and desolate aspect. There is no soil, the surface being barren limestone, whereupon but a few stunted bushes contrive to grow. Chemical denudation is at work, every joint and small crack in the limestone is widened, and its edges smoothed off by the solvent action of "carbonated water." The limestone is so pure that little argillaceous matter is left, after solution, to support vegetation, so that instead of the usual soil and grass-covered surface we have an arid corrugated waste, more resembling in appearance the "frozen fury" of a cooled lava-flow than the gentle undulating outlines we are accustomed to associate with weathered surfaces of stratified rocks in these islands. A. S. REID.

year. The price of these photographs is so small that they are sure to be much used in museums, colleges and schools for teaching purposes. The subscription list is nominally closed, but we understand that subscribers will still be admitted on the original terms until the end of November.

In congratulating the Committee of the British Association and its secretary on this admirable piece of work, the hope may be expressed that now the way has been shown, foreign societies, if they have not already done so, may follow suit; the subject is one that might well be brought before the notice of the International Geological Congress at its meeting next year in Vienna.

THE CRUISE OF THE "GAUSS" FROM CAPE TOWN TO KERGUELEN.

THE second part of the joint publication of the Berlin Institutes for Oceanography and Geography contains the official report of the work of the German Antarctic expedition on board the *Gauss* on its outward voyage from Cape Town to Kerguelen. The stay in Cape Town was prolonged in order to caulk the ship, which was leaking considerably though not to a dangerous degree, and to make certain changes in the gear and fittings which experience showed to be desirable. Six members of the crew were landed at their own request or as undesirables, and substitutes for them had to be found, and at the last moment two Norwegian volunteers were also taken on board. Prof. Drygalski acknowledges very warmly the hearty reception given him by the authorities at the Cape, which culminated in a military band playing German airs at the pierhead as the *Gauss* took her departure on November 27, 1901.

A course was set for Kerguelen, and the scientific work *en route* was reduced so as not to cause undue delay; still, the opportunity was taken to make thirteen deep-sea

soundings along a track where none existed before. Eleven of these were more than 1000 fathoms, five were more than 2000 fathoms, and the deepest was 2830 fathoms, in 42° 30′ S., 33° 45′ E. The weather was unfavourable with occasional calms, frequent head winds and almost always a very heavy sea rendered the ship extremely uncomfortable. The most interesting episode on the way was a landing which was successfully made on Possession Island of the Crozet group on Christmas Day. Possession Island and East Island came in sight at 5 a.m., the latter thickly veiled in fog, which gradually cleared. The landing was made in one of the numerous small bays of the north-west coast of Possession Island, where the party stepped ashore on a low basalt rock into an idyllic beast-world of slumbering sea-elephants, penguins drawn up in lines of military precision, and sea-birds fluttering curiously close overhead. The coast of the island as a whole was diversified with off-lying rocks and deeply cut caverns, the variety being due to the contrast of the alternate horizontal sheets of hard basalt and soft volcanic agglomerate. Moss grew luxuriantly, and above the cliffs the gentle slopes were in some places covered with marshy vegetation so deeply as to require the greatest care in crossing them. The sea-elephants and penguins furnished a supply of fresh meat which seems to have been appreciated on board; but the Kerguelen cabbage (which seems to have been nearly extirpated by rabbits in Kerguelen itself) was found bitter and unpleasant.

There was no trace of glaciation on the island. A puzzling appearance was presented by the loose material covering the slopes of one of the old craters and stretching down to the sea in stripes alternately wide and narrow in regular sequence, the wide of red, comparatively fine débris, the narrow of coarser fragments of black rock. Neither water nor wind action could account for these remarkable stone streams.

During the three hours on shore, large collections of every kind were made. Fifteen flowering plants were found, three times the number of species formerly known from the Crozets, though all are of species already known from Kerguelen or other islands of the South Indian Ocean. The fauna was found very rich in insects and spiders, several of the species not yet identified being apparently unknown in Kerguelen.

The voyage to Kerguelen continued until January 2, 1902, when the *Gauss* anchored in Observatory Bay, where the land party, who had arrived from Australia some months before, were waiting somewhat uncomfortably. The ship that had brought them had not been able to remain, and her Chinese crew had been such worthless workmen that the labour of installing the land station had been left for the crew of the *Gauss*, who had also to take on board the coal, stores and dogs that had been left for them. Much time was necessarily consumed in this work, everything having to be carried by hand to the boats and rowed out to the ship. About 130 tons of coal had to be left behind, the *Gauss* being full up with 400 tons.

The *Gauss* sailed on January 31 for her destination in the Antarctic with provisions for nearly three years on board. Prof. von Drygalski proposed to visit and if possible land on Heard Island, and then make straight for Wilkes' Termination Island, sailing along the ice towards the west so as to have the prevailing easterly winds of high southern latitudes in his favour, and ultimately turning southward and entering the ice. All on board were full of enthusiasm and confidence, satisfied with the ship, pleased with her equipment and determined to stay in the far south as long as they possibly could. The leader warns his friends not to suppose he is lost if pieces of wreckage from the *Gauss* should be discovered at sea, for she is very likely to lose some of her gear. He thinks it possible he may be able to send news home by June, 1903, but the expedition is planned for two summers in the ice, and no news will be good news until June, 1904.

Dr. Bidlingmaier appends a summary of the meteorological conditions of the whole voyage out from Hamburg to Kerguelen. There are two maps and several illustrations.

MR. CHAMBERLAIN ON EDUCATION.

MR. CHAMBERLAIN visited University College School on Wednesday, November 5, to unveil a memorial tablet to old boys who have fallen in the war, and was afterwards presented with an address from the students of University College. The address, read by the president of the Students' Union Society, referred to the keen support of higher education shown by the Colonial Secretary in his interest in the foundation of the University of Birmingham. We quote the following from the report of Mr. Chamberlain's reply in the *Times*:—

I thank you very cordially for the warmth of your reception. I appreciate the kindness which led you to offer to me this address. I have, as the address states, a very great interest in the higher education of the country. Thirty years ago some of us in Birmingham were prominent in securing for all the children of the country an efficient primary education. We thought it was right that, whatever might be the social position of any child born in this land, he ought to have, as it were, the tools put into his hands in order to carve out a career for himself. That, I believe, was a great and important work. As you know, the Government of which I am a member is now, at this very moment, engaged in the endeavour to develop it. But it left untouched a work which, perhaps, from one point of view, at any rate, is of even greater importance—that is the work of secondary and higher education. It is not everyone who can, by any possibility, go forward into the higher spheres of education; but it is from those who do that we have to look for the men who, in the future, will carry high the flag of this country in commercial, scientific and economic competition with other nations. At the present moment I believe there is nothing more important than to supply the deficiencies which separate us from those with whom we are in the closest competition. In Germany, in America, in our own colony of Canada and in Australia, the higher education of the people has more support from the Government, is carried further than it is here in the old country; and the result is that in every profession, in every industry, you find the places taken by men and by women who have had a University education. And I would like to see the time in this country when no man should have a chance for any occupation of the better kind either in our factories, our workshops or our counting-houses who could not show proof that, in the course of his University career, he had deserved the position that was offered to him. What is it that makes a country? Of course you may say, and you would be quite right, the general qualities of the people, their resolution, their intelligence, their pertinacity, and many other good qualities. Yes; but that is not all, and it is not the main creative feature of a great nation. The greatness of a nation is made by its greatest men. It is those we want to educate. It is to those who are able to go, it may be, from the very lowest steps in the ladder, to men who are able to devote their time to higher education, that we have to look to continue the position which we now occupy as, at all events, one of the greatest nations on the face of the earth. And, feeling as I do on these subjects, you will not be surprised if I say that I cordially agree with what is said in this address. I think the time is coming when Governments will give more attention to this matter, and perhaps find a little more money to forward its interests. When we are spending, as we are, many millions —I think it is 13,000,000*l*.—a year on primary education, it certainly seems as if we might add a little more, even a few tens of thousands, to what we give to University and secondary education.

THE REV. THOMAS WILTSHIRE, M.A., D.Sc.

THE Rev. Thomas Wiltshire, whose death, as already announced, took place on October 26, was for some years professor of geology and mineralogy at King's College, London. To geologists he was, perhaps, best known as the honorary secretary of the Palæontographical Society, a post which he held for thirty-six years, in the course of which time he laboured with unceasing energy in the editing of the annual quarto volumes.

He was educated at Trinity College, Cambridge, and, after taking his degree in 1850, he was ordained deacon by the Bishop of Rochester, and in 1853 priest by the Bishop of London. He resided for many years at the rectory, Bread Street, London, E.C., and took duty in various city churches. While at college his attention became arrested in geological subjects, but his literary contributions were few. Among them were essays on the Red Chalk of Hunstanton and on the history of coal. His work was mainly that of a helper of others. He was one of the earliest members of the Geologists' Association, and served as president from 1859 to 1862. Tothe Geological Society of London he rendered good service on the council, and for many years acted as treasurer. He had also been secretary of the Ray Society.

NOTES.

SCIENCE is represented in the long list of birthday honours by three names. Mr. W. H. Power, F.R.S., principal medical officer to the Local Government Board, has been made a Companion of the Order of the Bath; Sir J. J. Trevor Lawrence has been appointed a Knight Commander of the Royal Victorian Order; and Mr. H. J. Chaney, superintendent of the Standards Department, Board of Trade, has been made a Companion of the Imperial Service Order.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1903 at the anniversary meeting on December 1. The names of new members are printed in italics:—President, Sir William Huggins, K.C.B., O.M.; treasurer, Mr. A. B. Kempe; secretaries, Sir Michael Foster, K.C.B., and Dr. Joseph Larmor; foreign secretary, Dr. T. E. Thorpe, C.B.; other members of the council, Mr. W. Bateson, Dr. W. T. Blanford, *Prof. H. L. Callendar*, *Mr. F. Darwin*, *Prof. H. B. Dixon*, Prof. G. Carey Foster, Right Hon. Sir John E. Gorst, *Prof. J. W. Judd, C.B.*, *Right Hon. The Lord Lister, O.M.*, *Prof. G. D. Liveing*, *Prof. A. E. H. Love*, Prof. H. A. Miers, *Prof. E. A. Schäfer*, *Capt. T. H. Tizard, R.N., C.B.*, Prof. H. H. Turner, *Sir J. Wolfe Barry, K.C.B.*

ALL who are familiar with the services rendered to science and humanity by the late Prof. Virchow will be glad to know that a movement has been started with the object of erecting a statue to him at Berlin. It is felt by many admirers of Virchow that the memorial should be more than an exclusively German one, for his labours have benefited the world at large, and in this country in particular he has numerous disciples who would regard it a privilege to give evidence of their esteem for him. The proposed formation of a British Committee to assist the Berlin Committee of the Virchow Memorial will therefore meet with substantial support. Lord Lister has undertaken the chairmanship of the Committee and Sir Felix Semon is the honorary secretary *pro tem.* A meeting will shortly be held to elect officers of the Committee and decide upon a form of appeal for contributions. When the invitation to subscribe to the memorial has been issued, there should be a ready response to it, so that Great Britain shall be worthily represented at the monument of a great benefactor of the human race.

THE Earl of Crawford, F.R.S., who is about to take a winter tour round the world in his famous steam yacht *Valhalla*, has invited Mr. M. J. Nicoll, a member of the British Ornithologists' Union, to accompany him as naturalist. After passing through the Straits of Magellan, the *Valhalla* will visit the principal island-groups of the South Pacific, where its naturalist will have ample opportunities for collecting and observing birds and other animals. The return will be made by the Indian Ocean and Suez Canal.

A MOVEMENT is in progress at the Cape to establish in South Africa a society on the lines of the British Association, to be called the "South African Association for the Advancement of Science." Sir David Gill, K.C.B., F.R.S, H.M. Astronomer at the Cape of Good Hope, is to be the first president of the new association, and Mr. W. L. Sclater, director of the South African Museum, has been asked to preside over the zoological section. The first meeting of the association will probably be held at Cape Town at Easter next year.

THE seventh International Congress of Agriculture will be held at Rome next spring.

A REUTER message from Christiania announces, on the authority of Prof. F. Nansen, that an expedition under the leadership of Captain Amundsen will leave in 1903 for Greenland and King William's Land to locate the magnetic pole. The expedition will afterwards continue its way west and will return home *via* Bering Strait. Captain Amundsen will make systematic magnetic observations in the regions traversed, and will also carry on geographical exploration.

WE learn from the *Times* that M. Trouillot, the French Minister of Commerce, and M. Bérard, Under-Secretary for Posts and Telegraphs, are about to pay visits to all the inventors of systems of wireless telegraphy with a view to the ultimate adoption of one of them.

A REUTER telegram from Rome reports that the Captain of the Italian cruiser *Carlo Alberto* has informed the Italian Ministry of Marine that the vessel was in daily communication by wireless telegraphy with Poldhu, in Cornwall, throughout the voyage from England to Canada, and even when the vessel had entered Port Sydney Harbour. The telegram further states that this achievement confirms the possibility of holding simultaneous communications with Europe and America during the navigation of the Atlantic at least up to a distance of 3000 miles.

ACCORDING to the *Electrician*, some of the wireless telegraph messages transmitted from Poldhu to the *Carlo Alberto* on her recent cruise were recorded on installations not belonging to the Marconi Company or put up on their system. In the last issue but one a letter from the Marconi Company recalls, and repeats, the challenge which Mr. Marconi recently made to Sir W. H. Preece or Sir O. Lodge to show that they could pick up his messages, and questions the ability of the *Electrician* to prove that their messages were genuinely intercepted. In reply, the *Electrician* published last week the tape records with an article by Mr. Nevil Maskelyne describing the circumstances under which they were obtained at the wireless telegraph station erected by the Eastern Telegraph Co. at their cable terminus at Porthcwmow (Cornwall). We call attention to the discussion because it is of special interest in view of the proposed Berlin conference, and of the necessity which we have had occasion to point out on one or two recent occasions for consolidation of the competing systems of wireless telegraphy.

THE annual course of Christmas lectures, specially adapted to young people, at the Royal Institution, will be delivered by Prof. H. S. Hele-Shaw, F.R.S., whose subject is "Locomotion:—on

the Earth; through the Water; in the Air." The first lecture will be given on Saturday, December 27, and the dates of remaining are December 30, 1902, and January 1, 3, 6 and 8, 1903.

At the annual meeting of the London Mathematical Society to be held this evening, Mr. Robert Tucker is retiring from the office of honorary secretary. Mr. Tucker was elected secretary in 1867, very shortly after the foundation of the society, and has held the office continuously until now. During this long period he has grudged neither time nor labour in the interests of the society; it is in large measure owing to his zeal and devotion extended over so many years that the society has advanced from a comparatively local beginning to be the representative society of mathematical science in Great Britain. A circular has just been issued, signed by four past presidents of the society, expressing their belief that many members of the society will concur with them in wishing to offer to Mr. Tucker some permanent mark of their appreciation of his services, and requesting that subscriptions for that object may be sent to Dr. J. Larmor, St. John's College, Cambridge, as soon as possible.

Writing under date November 6, the Paris correspondent of the *Times* states that M. Lacroix, the chief of the French scientific expedition to Martinique, has sent a fresh report to the Colonial Office on the situation in that island. It appears that the zone devastated by the recent eruption is less extensive than was at first thought to be the case. The aspect of the volcano has much changed. A cone has been formed in the crater exceeding in height the former summit. So long as it exists the matter projected will fall in all directions instead of being localised as before on the southern and south-western slopes.

Prof. F. A. Forel sends us from Morges, Switzerland, a cutting from the *Gazette de Lausanne* of October 31 containing a letter in which he describes the sunset effects at Morges on the evenings of October 28 and 29. Half an hour after the disappearance of the sun, following the gradual extinction of the sunset colours, a peculiar secondary brightening of the western sky was observed and lasted for a second half hour. To begin with, the illumination was of a yellowish-green colour, becoming orange later, and sometimes shading into red near the horizon. Now and then a large, purple-lilac coloured circle with a faint halo and ill-defined contours appeared in the west, having for its centre the sun below the horizon. After observing these effects and noting their remarkable similarity to the sunset displays of 1883 following the eruption of Krakatoa, Prof. Forel expresses the conviction that the phenomena noticed by him in October are due to the impalpable dust particles in the higher regions of the atmosphere which are to be traced to the recent volcanic disturbances in the West Indies.

Particulars of the amounts contributed by the various Powers interested in the international scheme of the North Sea fisheries scientific investigation have been given by the Board of Trade. The amount to be expended in this matter by Great Britain during the next three years is 42,000*l.*, inclusive of 1250*l.* towards the maintenance of a central organisation at Copenhagen. The contributions of other countries (exclusive of the latter item) are as follows:—Denmark—initial expenditure, 9600*l.*; annual expenditure, 5500*l.* Germany—initial expenditure, 16,500*l.* (for steamer), 875*l.* (for equipment); annual expenditure, 6250*l.* Holland—initial expenditure, 666*l.* (instruments, &c.); annual expenditure, 2587*l.* Norway—initial expenditure, 9500*l.* (steamer); annual expenditure, 7370*l.* Sweden—initial expenditure, 1055*l.*; annual expenditure, 1066*l.* Russia—initial expenditure, 16,000*l.* (steamer without equipment); annual expenditure, 12,800*l.* Finland—initial expenditure, 6,000*l.*; annual expenditure, 2,228*l.*

The utilisation of the internal heat of the earth has often been suggested as an engineering problem of the future. The Rev. E. Rattenbury Hodges directs our attention to an issue of the *Boston News Bureau* in which a scheme is seriously proposed by the official geologist for Pennsylvania of the U.S. Geological Survey and also by Prof. Hallock, of Columbia University, New York, for drawing on the earth's internal heat by means of deep borings. The idea is to admit cold water into a deep boring and utilise the hot water and high-pressure steam produced. Mr. Hodges points out that he made similar suggestions in the *Popular Science News* for January, 1894, in an article on "Our Heat Resources of the Future." He remarked, however, at the time, "The great objection to this drawing on the earth's ancient store of thermal energy would be that her cooling and consequent shrinking would be accelerated; in other words, earthquakes would necessarily become more frequent, and possibly more violent and destructive in their effects."

The Atlantic forecasts issued at Washington are based on American, Atlantic and European telegraphic reports, and were begun, the chief of the U.S. Weather Bureau states in his last report, at the beginning of 1901. They were, on June 1 of the same year, made a part of the regular general night forecasts published by the Bureau. In a number of instances, when storms of marked strength were passing eastward off the American coast, advices were issued as to the character of the weather which would probably be experienced by steamers leaving European ports westward bound, and by an arrangement with Lloyd's these forecasts have been cabled over here. In addition to the daily forecasts of wind and weather and special storm warnings, predictions of fog have been issued when conditions favourable for fog developments have been indicated in the steamer tracks west of the fiftieth meridian. Reports from Transatlantic steamships have again and again verified these forecasts and special warnings.

The Meteorological Council has issued a valuable supplement to the temperature tables for the British Islands which were published in the early part of this year. Those tables gave the monthly means of the daily maximum and minimum readings for 117 places; the present volume contains the same stations, grouped as before under districts. The table for each month is divided into two parts, showing (1) the values for thirty years and for each five years (for the observations which extend over the whole time), together with the correction which must be applied to reduce the five years' period to the thirty years' period; (2) the five-yearly mean values for those stations for which the observations extend over less than thirty years, but for which an appropriate correction may be obtained from the values in the first part to enable the mean for thirty years to be computed with a fair approximation to accuracy. The work will be found very useful to actual or intending observers who may wish to compare their results with those of longer series at the same or neighbouring localities.

As already stated, the eruption of the St. Vincent Soufrière in the night of October 15–16 was followed by another considerable fall of volcanic ash on the island of Barbados, 100 miles to windward. The particles were found to consist chiefly of minute fragments of felspar, with a little volcanic glass, some ferro-magnesian minerals and a very little magnetite, thus differing considerably from the May samples, which consisted largely of ferro-magnesian minerals, with a considerable amount of magnetite. On this account, the dust of last month is likely to prove of greater fertilising value than that of May last. In connection with the latest dust-storm, the officials of the Department of Agriculture endeavoured to determine the effect produced on insect pests and other pests in the field. Two-

winged flies, "cow-bees," "wild-bees" and other Hymenoptera suffered severely, but other groups escaped practically unharmed, and there is no doubt that the dust has had little, if any, effect on the insect pests. The dust, in fact, destroyed not the pests, but the useful two-winged flies, &c., which prey on the caterpillars and other pests, so that in this way the volcanic ash has tended to disturb the balance of nature. Its effect is declared to be possibly a harmful one except in the case of the present corn crop, as the dust, lodging in the heart of the young plants, prevents the worms eating into the young leaves.

THE third part of the general report and statistics for 1901 relating to the output and value of the minerals raised in the United Kingdom, the amount and value of the metals produced, and the exports and imports of minerals, edited by Prof. C. Le Neve Foster, F.R.S., has been issued as a Bluebook. The first year of the new century has an unfavourable record so far as the mineral industry is concerned. Quantities have been smaller and prices lower. The value of the coal raised during 1901 represented 88·8 per cent. of the total mineral output for the year, but was six million tons less than the previous year, this being the first interruption in the steady rise since the great strike of 1893. Although the output of coal was less than in 1900, more persons were employed in and about the mines. The output of iron ore has continued to fall since 1899, and the diminution of $1\frac{3}{4}$ million tons in 1901 represents $12\frac{1}{2}$ per cent. of the quantity raised in the previous year. The comparative unimportance of the metallic ores, other than iron, is easily understood when it is stated that their value only amounts to 800,000*l.*, which is just half the value of the sandstone and far less than that of the limestone, the slate or the igneous rocks. The oil-shale mines of Scotland yield a product of greater money importance than the tin mines of Cornwall.

WE have received a report on observations of the tidal currents and undercurrents in the Strait of Dover, published by the Hydrographic Department of the Admiralty. The report consists of two parts. The first part contains observations made by Mr. M. F. J. Wilson, engineer-in-charge of the extension works at the Admiralty pier at Dover, with the object of ascertaining whether a report by divers, that the tidal stream changed its direction at the bottom a very long time before the surface, was correct; the result shows that the report was unfounded. The second part contains observations taken by Captain A. M. Field in H.M.S. *Research* in the Dover channel, in order to test the accuracy of conclusions suggested by the observations made by Captain W. V. Moore in 1896, to the effect that on the English side of the Strait the water below a certain depth was still, while the surface current was strong. The earlier observations are shown to have been erroneous, as the tidal streams run to the bottom of the Strait.

Terrestrial Magnetism and Atmospheric Electricity for September contains a biographical sketch of General Sir Edward Sabine, accompanied by a photographic reproduction of the portrait belonging to the Royal Society.

THE Italian Meteorological Office has forwarded us Nos. 4–6 of its *Bolletino mensuale*, or monthly weather review, containing a note on Count Almerico da Schio's attempts at aërial navigation. The form preferred by Count da Schio is a fish-shaped balloon with flexible keel, the Buchat motor yielded 12 horse-power, and the work of construction has been carried on in a private workshop.

A PAPER by Dr. Loria (Genoa), on the origin and development of geometry prior to 1850, has been translated in the *Monist* by Dr. G. B. Halstead. So far as it is possible to sum up briefly the author's conclusions, it would appear that: (1) While it is impossible to determine the first origin of geometrica research, it is certain that the Assyrians and Babylonians studied many important geometrical problems. (2) The geometry of the Egyptians was of far greater importance, and had a particular tendency towards practical applications. (3) Thales and the Ionic period represent the twilight preceding the dawn of Greek geometry. (4) The "golden period" of Greek geometry came within the Alexandrine epoch, its most conspicuous representatives being Euclid, Archimedes and Apollonius. (5) In the list of Greek geometers, Heron of Alexandria and Claudius Ptolemy play a prominent part, and the "silver period" of Greek geometry was notable for the appearance of Eutocius and Proclus, and especially Pappus. (6) The ascendency of the Romans and the subsequent middle ages represent a period of decadence for geometry. (7) The renaissance of mathematics commenced with the appearance of Leonardo Fibonacci (1200 *circa*), and before the end of the sixteenth century we note the names of Tartaglia, Cardan and Ferrari. (8) The primacy of mathematics in France was attained by the appearance of Viète, Mydorge, Pascal and Desargues; Henry Savile of Oxford and Kepler also belong to this period. (9) A new era was introduced by the analytical methods of Fermat and Descartes. (10) In the next section, Prof. Loria traces the influence of infinitesimal methods on the study of geometry, and (11) considers in particular the development of the study of curves and surfaces in three dimensions.

M. G. LIPPMANN, writing in the *Journal de Physique* for October, describes ingenious methods for verifying whether a ruler or sliding bar is rectilinear, and for fixing a collimator in the focal plane of a lens or telescope objective. For the first purpose he attaches one telescope with cross wires to a "chariot" which runs along the ruler, and observes the image of the wires in a second telescope which is fixed. If the two systems of cross wires remain coincident as the chariot runs along the ruler, M. Lippmann concludes that the ruler is rectilinear, and the only exception that could be made to this inference would be if the surface of the ruler formed a series of waves of length equal to the wheel-base of the chariot. To fix the collimating wires in the focal plane of a lens, M. Lippmann now fixes the auxiliary telescope to the chariot in such a way that it can be displaced parallel to its axis, and he uses it to view the wires in the telescope to be tested. If these remain unchanged in position when the auxiliary telescope is shifted, the collimation is correct; if not, the shift of the image determines the amount by which the wires must be adjusted in order to bring them into the focal plane of the lens. The chariot runs on a sliding piece which has been previously tested by the first method.

MR. BASIL THOMPSON, in his "Notes upon the Antiquities of Tonga" (*Journ.* Anth. Inst., xxxii. p. 81), describes the famous trilithon, or *Haamonga*. He inclines to one traditional account which relates that it was erected by Tui-ta-tui in the latter half of the fourteenth century. It was built for him to sit upon during the Kava ceremonies out of reach of his people, as he so dreaded assassination.

SEVERAL years ago, Mr. Henry Balfour published an important memoir on the musical bow, and in the current *Journal* of the Anthropological Institute (vol. xxxii. p. 156) he describes a superficially similar instrument, the *goura*, which Frobenius and Ankermann have confused with the musical bow proper. The *goura* is a bow-like instrument; one end of its string is fastened to a flattened quill, the other end of which is fastened to the bow, and the string is thrown into vibration through the medium of the quill, which is caused to oscillate by being blown upon. Those musical bows which have no resonator are held to the mouth when playing in order to increase the sound, but

with the *goura* the breath causes the vibration, whereas the vibration in the musical bow is caused by tapping or plucking the string.

THE November issue of the *Irish Naturalist* is entirely devoted to the Belfast meeting of the British Association, special attention being directed to papers connected with Ireland.

"PLANKTON" forms the subject of two papers in the *Biologisches Centralblatt*; the September issue contains an account of river-plankton by Mr. A. S. Skorikow, while in the October number Mr. W. Ostwald brings to a close his survey of the theory of plankton in general.

A RECENT issue (vol. iv. part iii.) of *Annotationes Zoologicae Japonensis* contains an account, by Messrs. Ijima and Ikeda, of a rare squid collected at a great depth in the Sagami Sea. The specimen, which is so delicate and translucent that it recalls a jelly-fish, evidently belongs to the genus Amphitretus, founded on a single somewhat damaged example dredged during the cruise of H.M.S. *Challenger*. It is apparently also referable to the type and only species of that genus, hitherto definitely known solely by the original specimen, although a squid taken some time ago in the Agulhas Stream may pertain to the same form. Amphitretus, as its name indicates, differs from all other cephalopods in having the mantle fused in the middle line with the siphon, so that there are two openings of the gills into the gill-cavity on each side.

MESSRS. LAMB AND HANNA have made some interesting experiments upon the neutralising power of anti-venomous serum towards cobra venom and upon the deterioration of this serum through keeping. They find that the maximum amount of venom injected by a cobra into a bite is 45 milligrams, and, assuming that man is as susceptible as the most susceptible animal tested, viz. the rat, estimate that for a man weighing 60 kilograms who received this injection, about 37 c.c. of the fresh serum would be required to save life. They also find that anti-venomous serum undergoes a progressive and fairly rapid deterioration when stored in hot climates, and that this deterioration is greater and more rapid the higher the mean temperature to which it is subjected (*Scientific Memoirs*, Government of India, new series, No. 1, Calcutta, 1902).

ACCORDING to the October number of the *Agricultural Journal* of the Cape of Good Hope, the Government entomologist, Mr. C. P. Lounsbury, has made an important discovery in regard to the propagation of the South African sheep and goat disease known as "heartwater." The so-called bont-tick has nitherto been found to be the only medium of spreading the disease. "A single specimen of this species, if fed on a heartwater-sick animal as a larva or 'seed' tick, has been found capable of transmitting the malady with fatal effect. An animal pastured on veld heavily infested by the tick may drop thousands of pathogenic larvæ during its period of illness and may thus indirectly serve for the almost total extermination of a flock in a few months. The terrible mortality amongst healthy flocks, brought to the coast where the tick is abundant, is thus easily explained. Pathogenic larvæ have been found to retain their dangerous character until they are adult. They may take their second or nymphal feeding on an ox or a non-susceptible goat, and then in the third or final stage get on to a susceptible sheep or goat and give it deadly fever. On the other hand, the disease appears to be non-transmissible through the egg-stage, and the species is normally non-pathogenic in all stages. A farm may be badly infested with bont-tick, yet be entirely free from heartwater." Since the other two common species are innocuous, it is hoped that by keeping down the bont-tick the disease may gradually be stamped out.

A MONOGRAPH of the North American Umbelliferæ, representing the joint work of Prof. J. M. Coulter and Dr. J. N. Rose, has been published in the seventh volume of contributions from the U.S. National Herbarium. The same authors treated this order also for North America in 1888.

THE second quarterly *Bulletin* published by the Botanical Department of Trinidad contains brief articles on the tonka bean, newly-imported mango trees and cane seedlings. Analyses of several Trinidad seedlings yield results which are very promising. An extra number, issued by the same authorities, deals with the cultivation and curing of vanilla in Tahiti. The species grown in that island is mainly *Vanilla pompona*, which yields a less valuable fruit than *Vanilla planifolia*. The former variety has this advantage, that the beans do not split so readily and are, therefore, more easily cured; also it bears flowers twice a year. Pollination is artificially performed, and an efficient worker is said to be able to pollinate two thousand flowers in an eight hours' working day. Curing is a very critical process, as the beans sweat on exposure to the sun, and they must then be covered with blankets and dried at an even temperature.

THE report of the Dominica Botanic Station during the year ending March 31, 1902, contains much valuable information on the work of the establishment, supplied by Mr. J. Jones, the curator; on the experiment plots at the Agricultural School, by Mr. Tannock; and on the cacao experiment plots, by Mr. Whitfield Smith, the travelling superintendent of the Agricultural Department. The monthly rainfall returns from twenty-five stations in the island are also given. Of the various experiments with economic plants, it is interesting to observe that the attempts to introduce early English potatoes are far from being successful at present. Of six varieties planted, three failed completely, two did fairly well and the sixth did excellently. A shipment of 480 pounds of these last was sent to Liverpool, but was not favourably received on the market, experts considering the tubers not bright enough. Still, it is hoped that with further experiments the island may yet compete with the Canary Islands in the production of early potatoes and other vegetables for the English market.

THE Imperial Department of Agriculture for the West Indies continues its series of useful pamphlets on subjects connected with the commercial development of these islands. Mr. A. Howard writes on the treatment of fungoid pests, dealing with them under the head of root, stem, leaf and fruit diseases. The information supplied is for the most part general, but reference is made to the immunity from the so-called "foot rot" or "mal-di-gomma" of sweet orange plants which have been grafted on sour-orange or grape-fruit stocks, and the advantage of treating sugar-cane cuttings with Bordeaux mixture and coating the ends with tar. A second pamphlet gives a number of recipes for cooking West Indian yams, and is issued with the intention of educating the English and American people to appreciate this vegetable.

WE have received copies of two papers read by Mr. H. W. G. Halbaum before the Institution of Mining Engineers, dealing with the difficult problem of mine ventilation and its reduction to simple graphical calculations. One of Mr. Halbaum's objects has been to furnish mining engineers with a form of diagram which shall fulfil the same purpose in the study of mine ventilation that has been so admirably served by Watt's indicator in the case of a steam engine. The second paper deals with an extension of the equivalent orifice theory, in which the writer calculates the relation between the orifice of the ventilating fan and that of the mine in order that the fan may develop its maximum efficiency. It is found that the efficiency is greatest when the orifice of the mine is between one-

quarter and one-half that of the fan, according to the kind of fan used. If the ratio of the orifices is one-third, the efficiency in all these fans is not more than 2 to 3 per cent. below the maximum, but it falls rapidly when the ratio is outside the limits ⅓ and ¼. Hitherto there has been a "good old theory" among colliery workers to have large airways and plenty of them, but this theory Mr. Halbaum compares to remedying the defects of a pump by enlarging its suction pipe. The investigation is largely based on the theories of Mr. Murgue, of St. Etienne, from whom, however, Mr. Halbaum differs in certain particulars. We hope the author will be successful in convincing mine owners that mathematical calculations are of more value than "good old theories," but the slow progress which mathematicians are able to effect in breaking down conservatism in other directions does not make his outlook hopeful.

WE have received the first number of *West India*, a bi-monthly illustrated magazine of thirty pages, published by Messrs. Lightbourn's Sons, price ten cents. Its contents are of a very general character, being "devoted to questions and persons and things generally," in prose and verse. The principal article in the issue before us is one by Mr. Francis Watts, on "Glimpses of the Leeward Islands." The Picture Stone, at Harte's Bay, St. Kitts, is dealt with in verse by Dr. Branch.

UNDER the title of *The Illustrated Scientific News*, a new monthly journal devoted to popular science has made its appearance, and we offer it best wishes for a long and successful career. With the second number, an excellent full-page portrait of Lord Kelvin is presented as a supplement The journal is concerned with inventions and other aspects of engineering work as well as with purely scientific advances. There are, for instance, articles on the 4·7 gun and the Diesel oil engine, as well as on such scientific studies as sounding the atmosphere with kites, Becquerel rays and Foucault's pendulum. Prof. H. H. Turner lightens the pages with a few anecdotes, and asks for other stories of scientific men and manners. This varied contents should find an interested public.

THE thirty-fourth volume of the *Transactions* and *Proceedings* of the New Zealand Institute, which deals with the year 1901, runs to 627 pages and is illustrated by 42 plates. When it is remembered that the Institute includes eight incorporated societies, the proceedings of each of which are here reported, and that the *Transactions* are concerned with zoology, botany, geology, chemistry, physics and miscellaneous subjects, the impossibility of describing the contents of the volume in a short note will be at once understood. In his presidential address to the Auckland Institute, Mr. J. Stewart considered, amongst others, the subject of technical education. He insisted that a youth cannot be taught a trade at a technical school in a manner to enable him to take his place among those who have served a regular apprenticeship to that trade; but that the use of his hands in mechanical handicraft is one of the easiest things for a young man to acquire. The great aim of technical education, he said, is to prepare the intellect to receive and master the scientific basis of all construction and of all manufactures. A paper, also read before the Auckland Institute, by Mr. Elsdon Best, describes very fully the diversions of the "Whare Tapere," a house where the young people of a village gathered at night in order to amuse themselves in various ways, and gives an account of the games, amusements and trials of skill practised by the Maori in former times. A second contribution by Mr. Best of the same date to the same society contains notes upon witchcraft, magic rites and various superstitions as practised or believed by the old-time Maori. Captain F. W. Hutton, F.R.S., is credited with numerous papers, treating of the beetles of the Auckland Isles and other zoological subjects. Other papers are by Profs. Dendy, Benham, A. P. W. Thomas, J. Park and T. H. Easterfield, and when the fifty-four articles brought together in the volume by the director of the Institute, Sir James Hector, K.C.M.G., F.R.S., are considered, the conclusion is reached that science is being worthily advanced by workers at the antipodes.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. T. Turner; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. E. C. Holland; three Indian Porphyrios (*Porphyrio calvus*) from Java, presented by Mr. A. D. Grange; a Woodcock (*Scolopax rusticula*) European, presented by Mr. W. C. Reid; two Common Chameleons (*Chamoeleon vulgaris*) from North Africa, presented by Mr. E. V. Wash; a Smith's Dwarf Lemur (*Microcebus smithi*) from Madagascar, a Barnard's Parrakeet (*Platycercus barnardi*) from South Australia, deposited; a Stone Curlew (*Œdicnemus scolopax*) European, purchased.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *b* AS OBSERVED IN CEYLON.—Mr. H. O. Barnard, of the Ceylon Survey, has communicated some interesting details of Comet 1902 *b*, as observed by him in Ceylon, to the *Ceylon Observer* of October 11.

He records the comet's appearance, using a telescope of "moderate power," as an egg-shaped mass of nebulosity having a very distinct star-like nucleus which is of a reddish colour, and a tail which extended to about 1°·5 from the nucleus on October 7, giving the whole object a "tadpole" appearance; he further adds that it was easily visible to the naked eye, whilst an opera-glass showed a faint trace of the tail, but no nucleus.

Mr. Barnard's computations show that the comet increased its distance from the earth by 45 million (37 million to 82 million) miles during the period October 8 to 28, inclusive, and that its diameter was 200,000 miles, its volume 600 times that of the earth, whilst the length of the tail, on October 7, was about one million miles.

Mr. Barnard expects the comet to be visible again, in Ceylon, just before sunrise in December.

NEW MINOR PLANETS.—Prof. Max Wolf announces, in Nos. 3821 and 3824 of the *Astronomische Nachrichten*, the discovery of five new minor planets. The dates of discovery, positions and magnitudes of these objects are as follows:—

Planet.		Date.		Heidelberg M.T h. m.	α h. m.	δ ° ′	Mag.
1902	J.V.	Oct.	7	10 38·8	2 9·7	+10 55	12·5
,,	J.W.	,,	7	13 25·8	2 5·2	3 18	13·0
,,	J.X.	,,	7	,, ,,	1 52·9	2 55	13·5
,,	J.Y.	,,	24	12 10·3	1 55·2	12 14	13·5
,,	J.Z.	,,	24	,, ,,	1 59·2	+12 59	13·0

The daily movements of the respective planets are J.V. −0m.·7, −2′; J.W., −0m.·8, −6′; J.X., −0m.·7, −6′; J.Y., −0m.·8, −6′; J.Z., 0m.·7, −8′.

The planet discovered by Prof. Wolf on October 7 and designated 1902 J.U. proved to be the same as (106) Dione.

NEAR APPROACH OF COMET 1902 *b* TO MERCURY.—A telegram from Prof. Pickering, dated Cambridge, Mass., October 29, announces that Prof. Seagrave finds that Comet 1902 *b* will approach to within two million miles of the planet Mercury on November 29.

Herr M. Ebell, Kiel, has confirmed this telegram from the parabolic elements published by Herr Elis Strömgren in No. 3821 of the *Astronomische Nachrichten*, and which were computed from observations made at Lick (September 1), Nicolaiew (September 20·4) and Strasburg (October 8·4). From the ephemeris accompanying these elements it is seen that the declination of the comet will be too southerly for any further observations to be made in England until about the middle of February, and that its brightness at that time (February 11) will be only 2·1 times its brightness at the time of its discovery, whilst by the end of February this ratio will be reduced to 0·6 (*Astronomische Nachrichten*, No. 3821).

THREE STARS WITH LARGE PROPER MOTIONS.—M. A. Verschaffel communicates to No. 3824 of the *Astronomische Nachrichten* the positions of the stars B.D. $+24°\cdot2439$, $24\cdot2733^1$ and $24\cdot2733^2$, as recently observed by him at Abbadia, and compares them with the positions given in the catalogue A.G. Berlin B. and brought to 1900 by the corrections for precession and secular variation given in the catalogue, thereby demonstrating the existence of a large amount of proper motion for each star.

THE PYRAMID SPOT ON JUPITER.—Herr Leo Brenner, in writing to *The Observatory* (No. 324), explains the great discrepancies which have appeared between the positions, and velocity, of the "pyramid" spot as determined by himself and as determined by the English observers Messrs. Denning and Phillips.

He found that the centre of the formation travelled, during a year, at the mean velocity of $0°\cdot5$ per day, and then Messrs. Denning and Phillips recorded that, according to observations made on June 28, it had moved at a mean velocity of nearly $7°\cdot0$ per day for a period of nine days. This great change of velocity seemed impossible, but Herr Brenner has found a solution to the difficulty in the observed fact that it is not *one* spot that is being observed, but a series of three or four spots, and of these, some are new formations of which Messrs. Denning and Phillips had measured the position as though they were portions of the original spot, thus obtaining the great differences in position noted above.

Herr Brenner has arrived at the conclusion that neither the markings seen by him during August and September, nor those seen by the English observers on June 28, can be identical with the "pyramid" spot of last year, and these conclusions are strengthened by the observations of Señor Comas Solá, which were published lately in the *Bulletin de la Société Astronomique de France*.

EPHEMERIS FOR COMET TEMPEL$_3$-SWIFT.—In continuation of the ephemeris given in *Astronomische Nachrichten*, No. 3811, M. J. Bossert now publishes the following ephemeris for this comet.

12h. M.T. Paris.

1902.	R.A. h. m. s.	Decl. ° ′	log r.	log Δ.
Nov. 10	20 3 45	−16 6·2	0·1697	0·1596
,, 15	20 14 42	−15 26·6	0·1591	0·1603
,, 20	20 26 19	−14 42·2	0·1486	0·1606
,, 25	20 38 35	−13 52·6	0·1383	0·1603
,, 30	20 51 29	−12 57·5	0·1282	0·1595
Dec. 5	21 4 57	−11 56·3	0·1184	0·1584
,, 10	21 19 0	−10 49·5	0·1089	0·1566
,, 15	21 33 38	− 9 36·7	0·1000	0·1546
,, 20	21 48 51	− 8 17·4	0·0917	0·1525
,, 25	22 4 35	− 6 52·0	0·0843	0·1502
,, 30	22 20 51	− 5 21·0	0·0776	0·1479

Kiel Circular, No. 53.

THE AUTOMATIC TELEPHONE EXCHANGE.

THE object of the automatic telephone exchange is to dispense with the assistance of a third party in making connection between two subscribers. Those who are at all familiar with the complexity of the connections and of the numerous devices needed in a modern exchange having a large number of subscribers will realise that to work out a system in which the telephone girl is replaced by an automatic arrangement is a matter requiring no little ingenuity, and will, perhaps, not be surprised that the problem has apparently only been attacked successfully on the other side of the Atlantic. The American technical papers have shown that, during the past few years, the construction of automatic exchanges has received considerable attention and that several different systems have been worked out. Some attempts have been made to introduce these into this country, but not with much success; in fact, until the last year or so England did not afford a promising field for the introduction of automatic telephones unless for small private exchanges. In America, however, matters are different, and, as we have said, descriptions of two or three different systems in actual or experimental use have been published. One of these, recently described in the *Scientific American*, is noteworthy for the fact that the automatic apparatus at the exchange is operated mechanically so far as possible, the electrical control being reduced to a minimum. Greater trustworthiness, it is said, is obtained by this means, though we should be inclined to think that the wear and tear would also be greater. We do not know whether this, the Faller, system has had any extensive trial as yet. Another system, which we propose to describe briefly, has been in operation in some parts of America for three or four years, and as it is being installed now in several large American towns, and is also being introduced into Germany and England, we may judge that it has proved both trustworthy and economical. In Chicago, an exchange on this system is being constructed with an ultimate capacity of 100,000 subscribers.

This system is known as the "Strowger" system. We have had an opportunity of inspecting a small model installation representing part of an exchange suitable for 10,000 subscribers, and were struck by the ease and simplicity of its working and its great convenience from the subscriber's point of view. Of course, working a small portion of an exchange under exhibition conditions is one thing and running the complete system continuously, with all the subscribers connected, is another; but there was little to lead one to suppose that the working under the more arduous conditions of actual service would be any less satisfactory, and indeed the success which has attended the operation of three or four large exchanges in America is direct evidence to the contrary. One of these, at Fall River, Mass., has been in operation for two years and, with an ultimate capacity of 10,000 subscribers, already has 4000 connected. Apart from the clerical staff, only five people are required to look after this exchange, and these are said to spend most of their time connecting up new subscribers; at night and on Sundays the exchange is left to take care of itself.

We may first of all consider the subscriber's instrument; this takes no more room than, and looks very much like, an ordinary wall set. There is, however, no magneto ringer, and on the front of the box is a circular metal disc having ten holes on the right-hand side numbered from 0 to 9; below this is a ringing-up push. Suppose a subscriber wishes to call up No. 5683; he takes his receiver off the hook in the usual manner and, putting his finger in the hole marked 5, rotates the disc until his finger comes against a stop; he then allows the disc to return to its normal position and repeats the operation with the holes marked 6, 8 and 3 in succession. He is now connected through, and if No. 5683 is engaged, will hear a buzzing in his receiver; if not, he has only to press the ringing-up push and wait until his call is answered. When he puts back his receiver on the hook, all the connections are restored to their original condition. The time taken to get connected through—or to find out that the number you require is engaged—is considerably less than with the ordinary system, even when the exchange girl replies to your call and connects you up immediately, which, as telephone users know, happens but rarely.

The apparatus at the exchange consists of a number of automatic switches known as "first" and "second selectors" and "connecting switches." The construction of all these is very similar, but is too complicated to describe in detail; we can only indicate the principle upon which they work. The switch consists of a semi-cylinder, along the axis of which is the switch-arm. This arm can be raised or lowered in ten steps and also rotated so that its contact can be brought up to any of the contacts on the inside of the semi-cylinder; these are arranged in ten rows of ten contacts each. We may best understand the operation of these switches by following out what happens on ringing up, say, No. 5683. Each subscriber has a "first selector" switch of his own at the exchange, and the first movement of the dial on his instrument operates this switch. As he draws down the hole 5 to the stop, a succession of five current impulses are sent along the line, and these raise the central switch-arm to the fifth row up on his switch. This picks out all the subscribers whose numbers begin with 5000, by connecting the caller to the group of "second selectors" corresponding thereto; there are ten connecting or "trunk" lines leading from the first selectors to the second, and the switch-arm, when it has risen to the fifth row, rotates until it picks out a disengaged trunk, passing over any which are in use by other subscribers. The second movement of the dial operates the second selector in precisely the same way, raising its arm to the sixth row of contacts and causing it to rotate over that row until it picks out a disengaged trunk line leading to the group of subscribers with numbers beginning with 5600. The remaining two movements operate the selector switch and are

slightly different; the first raises the arm to the eighth row of contacts and the second rotates it to the third contact in that row. The subscriber is now connected to No. 5683 and can ring him up if he is not engaged; the signal that he is engaged is given through another set of contacts on the connector switch, an interrupted current being sent along the caller's line and causing his receiver to hum. When the conversation is finished and the caller hangs up his receiver, all the switches which he has been using return to their normal position of rest.

The exchange is run on the central-battery system and metallic circuits are used throughout. It will be noticed that the subscriber's connections are duplicated at the exchange, one pair of wires running to the first selector and one to the contacts corresponding to his number on the connectors. It is also obvious that the number of connections in one group of hundreds or thousands which can be made at once is limited by the number of trunk lines; ten of these per hundred subscribers have been found to be practically sufficient, but the number could, of course, be increased without limit if it was found desirable. Once two subscribers are connected through, their conversation cannot be interrupted, since any attempt to call either up results merely in the caller receiving the busy signal, and any calling up between other subscribers does not affect the lines they are using. This alone is a very great convenience from the user's point of view; in addition, the gain in time in getting connected up, the impossibility of getting on to a wrong number except by the subscriber's own fault and the secrecy of the system must be reckoned to its advantage. So far as the exchange is concerned, the chief advantage lies in doing away with the exchange girl; the cost of maintenance is said to be no more than in a manually operated system, the floor space required for connections and switches about the same; there is, therefore, a slight saving in room, since none of the resting rooms which the strain upon the operators now renders necessary is required.

M. S.

INSTANTANEOUS CHEMICAL REACTIONS AND THE THEORY OF ELECTROLYTIC DISSOCIATION.[1]

IT is generally held that instantaneous chemical reaction, if not all chemical action, is dependent upon ions; in other words, that such reactions take place between electrolytes. In order to test this point, the author has attempted precipitation by double decomposition (like the reaction between silver nitrate and hydrochloric acid) in solutions that are excellent insulators. As a solvent benzene was chosen, though it seems that petroleum ether or toluene would have been equally good. The benzene used was the best that is made by Kahlbaum, free from thiophen. It was allowed to stand for days over phosphorus pentoxide, from which it was distilled, and was finally kept standing over metallic sodium. The conductivity was tested by comparison with that of air. For this purpose an Arrhenius resistance cell, with plates less than a millimetre apart, was placed in series with a sensitive galvanometer, and a dynamo giving a pressure of 110 volts. When the cell contained air a slight movement of the needle could be seen on closing the circuit, and on replacing the air by benzene the deflection was somewhat less. The insulating properties were therefore good.

Some difficulty was found in obtaining suitable solutes owing to the general insolubility of salts in hydrocarbons. Certain oleates, however, are soluble, and those of copper, nickel and cobalt were used. These were prepared by heating pure oleic acid with the calculated quantity of standard solution of sodium hydroxide and then adding to this sodium oleate solution a slight excess of the sulphate of the heavy metal. The precipitate was thoroughly washed with water and finally dried at 110°. The salts so obtained were analysed by reduction in hydrogen.

These oleates are readily soluable in benzene, even in the cold, and give colours similar to those of salts of the corresponding metals in aqueous solutions. On heating the dark red solution of cobalt oleate in toluene it turns blue, and on cooling it again becomes red, in the same way as cobaltous salts change colour in aqueous solutions. It was found that 5 per cent. solutions did not conduct any better than pure benzene. Metallic sodium does not cause any precipitation, and was, in fact, used as a desiccating reagent; the only change that ever took place was the usual slight pinkish coloration that freshly cut surfaces always assume after a time. Magnesium, aluminium and zinc have been kept in a copper oleate solution for weeks without in the least changing their appearance and lustre. It is therefore abundantly proved that these oleates in benzene are not ionised. Cryoscopic determination of the molecular weight of copper oleate in benzene gave figures about 2400 and the boiling-point method about 2650, whereas the theoretical figure is 625·6, so that, according to the usual idea, the copper oleate would appear to be polymerised.

A solution of dry hydrochloric acid gas in benzene was next prepared. The gas was obtained by dropping the aqueous solution into concentrated sulphuric acid and further drying by sulphuric acid and phosphoric anhydride. The conductivity of this solution was no higher than that of the benzene itself. It does not attack the carbonates of sodium, calcium and barium, or bright magnesium ribbon. Zinc, however, is attacked, whether amalgamated or not, but platinum in contact with it makes no difference, the hydrogen being evolved from the zinc alone. Thus voltaic action is absent. A dilute aqueous solution of the acid seemed to act rather less readily on amalgamated zinc than did the solution in benzene. Similarly, contact with platinum or other metals does not cause magnesium to be acted on by the acid. Iron, nickel, cobalt, copper and cadmium are not attacked; tin and aluminium are slightly acted upon, and lead very slightly. This is so whether the metals are by themselves or in contact with others. Metallic sodium is fairly rapidly attacked. The chlorides of the metals acted upon are practically insoluble in benzene.

In all the experiments, great precautions were taken against moisture, the generators and other apparatus being connected to suitable drying trains. The flask containing the benzene and substance to be tested was fitted with a doubly perforated rubber stopper, and was connected with the drying train of the hydrochloric acid generator and also to a large tower filled with pumice and phosphoric anhydride. Before introducing the benzene and substance, the flask, stopper and connecting tubes were heated to drive off moisture, and while still hot, the benzene and substance to be tested were quickly introduced and the whole at once connected with the train. The air was then displaced with dry hydrogen, which passed through the hydrochloric acid generator, and finally the acid was slowly evolved until the train was saturated.

When dry hydrochloric acid gas is passed into a solution of copper oleate in benzene, there is formed instantly a heavy brown precipitate which is cupric chloride. We have here, then, a case of instantaneous precipitation by double decomposition which is perfectly comparable with that of the formation of silver chloride in aqueous solutions, when silver nitrate solution is treated with hydrochloric acid. Yet the benzene solutions conduct no better than benzene itself, nor is there the least perceptible increase of conductivity at the instant of the formation of the precipitate. The oleates of nickel and cobalt, when treated in benzene solutions with dry hydrochloric acid, react in a perfectly analogous manner. Analysis showed the precipitation to be complete.

It was found that the conductivity of two samples of anhydrous stannic chloride is no better than that of air. This salt mixes with benzene in all proportions, giving mixtures which are equally non-conductors. Yet when such a solution is poured into a benzene solution of copper oleate, there forms *instantly* a heavy brown precipitate which is principally anhydrous cupric chloride. The precipitate takes down some of the stannic oleate which is formed with it and is difficult to manipulate, but analysis shows that the reaction is in the main a simple double decomposition.

Anhydrous phosphorus trichloride, arsenic trichloride and silicon tetrachloride are miscible in all proportions with benzene and give solutions which are insulators, like the solution of stannic chloride. In each case, when a solution of copper oleate in benzene is treated with a solution of PCl_3, $AsCl_3$ or $SiCl_4$ in the same solvent, copper is precipitated as a dark brown precipitate. This is essentially cupric chloride, but is in each case contaminated with some of the oleate.

We see, then, that HCl, $SnCl_4$, PCl_3, $AsCl_3$ and $SiCl_4$ each precipitate cupric chloride from benzene solutions of copper oleate. There is, then, apparently double decomposition by means of ions, and yet the solutions are non-conductors, showing that ions are not present.

[1] Abstract of a paper in the *Journal of Physical Chemistry*, vol. vi. pp. 1-14, 1902, by L. Kahlenberg.

As in the case of aqueous solutions, the solubility of the precipitate is diminished by adding excess of the precipitant. When dry hydrogen sulphide is passed into benzene solutions of the oleate of copper, nickel or cobalt, the sulphides of the metals are at once thrown down. If these solutions are first saturated with hydrochloric acid so as to precipitate the chlorides and then saturated with dry hydrogen sulphide, the sulphides do not form. Stannic chloride dissolved in benzene was treated with dry hydrogen sulphide in large excess without any visible formation of sulphide; but on standing overnight there was a copious precipitate. Arsenic trichloride in benzene showed a similar reluctance to form sulphide, but when petroleum ether was used as a solvent the formation was almost instantaneous.

Hughes has found that dry hydrochloric acid will not react with dry ammonia, a fact which the author has confirmed. Yet when anhydrous benzene is treated with hydrochloric acid dried over sulphuric acid and phosphorus pentoxide, and then ammonia (evolved by heating lime mixed with ammonium chloride and dried by passing through a tower of lime and one of dry pumice covered with phosphorus pentoxide) is passed into the solution, a white, bulky precipitate of ammonium chloride at once forms; the benzene vapours are enough to cause the reaction to take place. Neither of the solutions, nor the mixture, conduct better than benzene itself, nor is there any change of conductivity at the instant of mixing. Similarly, when anhydrous pyridine is mixed with benzene, the solution is a non-conductor. But when such a solution is mixed with a solution of hydrochloric acid in benzene there is at once formed a heavy precipitate of the hydrochloride.

We must therefore conclude that instantaneous chemical reactions are possible with non-conducting solutions as well as with electrolytes. W. R. C.

A MEDIÆVAL TREATISE ON SURVEYING.

PROF. HAMMER, of Stuttgart, who has from time to time published interesting contributions to the history of geodesy and of surveying instruments, has given in a recent number of the *Zeitschrift für Vermessungswesen* a detailed account of Reinhold's treatise on surveying and mine surveying, a little-known work that enjoyed great popularity in Germany in the Middle Ages. In the bibliography appended to Brough's "Mine Surveying" (ninth edition, 1902, p. 360), Reinhold's book appears as the earliest independent treatise on the subject. In view of the far-reaching influence exercised by the work, a brief analysis of the contents may not be without interest.

The title of the book is "Gründlicher und warer Bericht vom Feldmessen" It was published at Saalfeld in 1574 by his son, Erasmus Reinhold. Reinhold senior was born at Saalfeld in 1511 and died there of the plague in 1553. From 1536 until his death he was professor at Wittenberg. The main contents of the book would appear, therefore, to have been written in the middle of the sixteenth century. The preface, written by Erasmus Reinhold junior, a physician, gives examples of errors made in surveying. Thus, a large forest was measured thrice; the first determination gave an area of 26,000 acres, the second 36,000 acres, and the last 27,000 acres. The author divides his "Bericht" on surveying into five sections. The first deals with the four rules of arithmetic, the extraction of square roots, &c.; the second deals with the calculation of areas; the third with the dividing up of land; the fourth shows how the rules given may be applied in districts where other measures of area are in use; and, lastly, the fifth section enumerates the rules of surveying so as to enable, as the author puts it, a common man of sufficient intelligence to carry out his own measurements without further great ado. The second part of the work is devoted to an account of the quadrants and of the compass, and to a treatise in nineteen chapters on mine surveying.

In the first part of his book Reinhold complains that it is rare to find a town which uses the same names and sizes for field surveying as its neighbours. Morgen, Juchart, Tagwerk, Mannsmahd, Hufe, Hufacker, Artacker, &c., are among the units of area met with. He therefore carefully enumerates his measures of length and area, with the symbols used for them throughout the book. The unit of length is the rod (*Ruthe*) of 16 feet (*Werkschuh*), each of which is again divided into 16 finger-breadths (*Fingerbreit*). The unit of area is the acre (*Acker*) of 150 square rods (*gevierdt Ruthen*). The Werkschuh, on which his whole system of measures is based, is dealt with by Reinhold in a peculiar manner, very characteristic of the period. He says in effect: how long, however, a Werkschuh is, is known to everyone, or can easily be ascertained from any carpenter, mason or cabinet-maker. Later on in the volume he gives a woodcut showing the length of a third of this foot, from which it is evident that the Werkschuh was 281 millimetres long, and consequently the Ruthe was 4·50 metres long, which is in close accord with the old Brunswick rod of 16 feet (4·566 metres). A square rod would represent 20¼ square metres, and the unit of area, the Acker, would contain about 3040 square metres, which is in fair accord with several of the Morgen in use in Germany before the introduction of the metric system. For the measurement of lengths, Reinhold advocates the use of a cord or rods. A wire cord is preferred to a hemp one, as not being affected by weather or by varying tension. For setting out a right angle the author makes use of the right-angled triangle with the sides 3, 4 and 5. He also recommends the numbers 20, 21 and 29, as well as the approximation with the numbers 12, 12 and 17 ($12^2 + 12^2 = 288$, whereas $17^2 = 289$). In reference to the latter method, he reminds the reader that he writes for the common man who does not require everything to be weighed on a gold-balance. Areas are calculated by means of rectangles, trapezoids and triangles, attention being given to the measurement of lakes and woods and other polygonal figures in which diagonals cannot be measured. For the measurement of angles the compass is used. It is graduated into single degrees, each 5 degrees being numbered consecutively from 0 to 360°. The direction of the pointer in the illustration given represents a westerly declination of about 6°. Lastly, the trigonometrical solution of triangles by the aid of a table of natural sines is explained. The next section of the work deals exhaustively with the division of land. Errors, it is pointed out, frequently occur which a good surveyor could easily prevent. Every prince and town, therefore, should, as the author quaintly puts it, have a licensed, but nevertheless competent, surveyor. The second division of the whole work is devoted to mine surveying. The instruments described include the compass, a good quadrant, a water-level and a hanging clinometer. The unit of length in mine measurements was the *Lachter* (fathom) of 6 shoes, and the technical terms then used were much the same as those now in vogue in German mines.

Such in brief are the contents of this remarkable treatise written 350 years ago. Comparing it with some of the most recently published text-books on surveying, it is depressing to find how little is the progress that has been made in the instruction in this important branch of engineering. In a large treatise on the subject published this year the statement is made that a slight knowledge of geometry is necessary, and consequently a chapter is inserted in the middle of the book dealing with geometry, trigonometry and logarithms. The development of the theory of measurements and the mathematical principles on which it is based are neglected, and the author confines himself to enunciating mechanical rules for the testing of surveying instruments and for carrying out surveys. This rule-of-thumb method of education was not enough for Reinhold in 1550, whilst in 1782 Prof. Lempe, in his lectures at the Freiberg School of Mines and in his text-book, went still further by urging the necessity of learning and applying arithmetic, geometry, plane and spherical trigonometry, and even analytical geometry and the elements of the differential and integral calculus, as the surest basis of a successful study of mine surveying. B. H. B.

DYNAMIC INTERPRETATION OF CELL-DIVISION.[1]

THE author came to the study of biology possessing, as a civil engineer, an equipment rare among the disciples of this science. Some years ago he interpreted the phenomena of cell-division and karyokinesis as due to the play of Newtonian forces of equal potential but opposite sign, rather than to the gross actions of pull or push performed by ordinary mechanical forces; and was able to reproduce the spindle-figure and centrosomes by a trough full of spirits of turpentine in which were suspended crystals of sulphate of quinine, and into which were introduced a pair of wires joined to the poles of an electric machine. After continued study under such masters as Giard, he now develops

[1] "Interpretacion Dinamica de la division Cellular." By A. Gallardo. Pp. 101. (Buenos Aires, 1902.)

the same conception and extends it in a thesis for the doctorate. The cytoplasm of a dividing cell is differentiated as the site of a field of force; the spindle with its asters is the visible embodiment of the lines of force; the centrosomes occupy the poles, that is the points of maximum potential and of physical equilibrium, though it is not legitimate to say that they are themselves either the sources or the causes of the molecular stresses and strains. Where the centrosome expands into a large zoned astrosphere, as in the eggs of Rhynchelmis or Unio, the zones correspond to equipotential surfaces. It has been objected to such views that they will not explain multipolar figures, such as often occur in nature: but a tripolar figure can be formed in the above *electric* working model by introducing a third terminal put

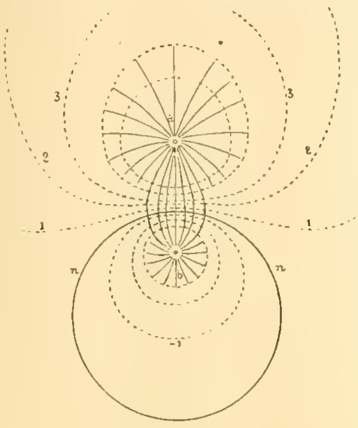


FIG. 1.

to earth; while a quadripolar spindle can be reproduced by a *magnetic* model where iron-filings group themselves under the action of four poles alternately arranged at the consecutive angles of a square. But perhaps the most convincing illustration is supplied by two consecutive figures; the one (Fig. 1) is a geometrical construction to represent the plane section of a field of force passing through the poles, and displaying the system of equipotential zones and lines of force, when the charges at the poles are + 5 and − 3 respectively; and the other (Fig. 2) is the de-

FIG. 2.

lineation of an unequal mitosis in the connective tissue of a salamander-larva copied from F. Reinke.

The splitting of the chromosomes and the repartition of their twin moieties are referred to the same forces, which he terms "karyokinetic" not to prejudge their real nature. He suggests that in direct or amitotic divisions of the cell and nucleus the same forces are at work, although no material presentment of the lines of force is seen.

The whole of this part is admirably worked out: it is quite free from those mathematical short-cuts, which are, indeed, indispensable for the rapid daily work of the physicist, but which Faraday, the great investigator of polar forces, was able to dispense with, and which are for the most part incomprehensible if not revolting to the biologist.

Gallardo regards heredity as the transmission from cell to cell of the power to develop such forces in due course. That these forces are neither electric nor magnetic is certain. It is unlikely that Bütschli's suggestion that they are osmotic is adequate, though doubtless osmosis does play a part in the process. Gallardo is content for the moment to regard them as "vital" forces, avowing that he is so far a vitalist as to admit that the phenomena of living beings present problems and characters not found in inorganic or dead groupings of matter. He does not, however, accept J. Reinke's "dominant" hypothesis.

We ourselves greet this pamphlet the more cordially as embodying ideas that we have held for years—nay, have attempted to work out. The task, however, could only be accomplished by one who possessed a solid grasp of modern physical science as well as of biological fact. We may note that the device we have adopted for modelling in three dimensions the karyokinetic figures—a glass trough of glycerine in which are suspended the finest iron-filings, levigated in alcohol—will be found useful by the physicist; for by moving it from place to place in a magnetic field he can render the courses of the lines of force visible, and map them out in space for himself or his students.

MARCUS HARTOG.

THE RABBIT PEST IN AUSTRALIA.[1]

IT was hoped and expected that the long-continued drought which has prevailed throughout eastern Australia for the last six years would at least have had a good influence in subduing the rabbit pest, but such does not seem to have been the case. The rabbits, like all other living animals, have suffered severely in certain districts, but on the least mitigation of the drought they quickly recover themselves, and become as numerous and as destructive as ever. Large tracts of country formerly able to maintain sheep have been abandoned, we are told, on account of the rabbit pest, and have gone to waste in consequence of the futility of the various schemes that have been tried for the mitigation of this frightful evil.

In these circumstances, Mr. William Rodier, of Tambua Station, Cobar, New South Wales, has done well to reprint the pamphlet on this subject to which we directed attention on a former occasion (NATURE, March 21, 1889), and to explain more fully the very simple and efficacious method by which he proposes to deal with the rabbit pest. Had the scheme put forward by Mr. Rodier been adopted when it was first suggested, we do not doubt that the success which it has met with on his own station would have followed it elsewhere. But, as we all know too well, the prophet has little honour in his own country, and, instead of following Mr. Rodier's excellent advice, the authorities have tried various other schemes that have in many cases only had the effect of augmenting the evil.

Mr. Rodier's plan for combating the rabbit pest is very simple. It is based on the well-known law of nature that polygamy is favourable to the increase of offspring and polyandry is unfavourable. Rabbits usually live in a polygamous state. One male impregnates a number of females and produces a large offspring. Mr. Rodier proposes to convert this polygamy into polyandry by catching the rabbits alive and killing all the females, while all the males are turned out again. If this is done, the male rabbits become more numerous than the females, harass the females by their constant attentions and injure their powers of breeding. Thus the offspring becomes continually less numerous. That this result will follow is illustrated by the case of public women, who seldom bear children and never produce large families, and by other facts well known to science.

The ordinary course pursued in trapping rabbits, in which all that are caught are killed, so far from diminishing the evil is much more likely to increase it. The great majority of the rabbits captured are sure to be males, because the male rabbits have the habit of congregating in certain spots called "buck-heaps." In these spots they are easily caught by the trappers, who are, of course, only anxious to kill as many as possible and to obtain the fees offered for their destruction by the Rabbit Acts. Thus the males become diminished in numbers and the breed becomes increased. Various other modes of combating the rabbit pest have been tried in Australia, but all alike have proved to be failures. Poisons of different descriptions have been much

[1] "The Rabbit Pest in Australia, its Cause and its Cure." By W. Rodier, Pp. 16. (Sydney, 1902.)

used. This is done by spreading poisoned grain about the runs of the rabbits or by poisoning the water-tanks. But poison has not turned out successful, and there is besides great objection to the employment of such a dangerous agent in any case.

The introduction of some infectious disease to kill the rabbits has also been advocated, and even tried in certain districts, but it has not succeeded. In this instance, even Pasteur attained no definite result.

In these circumstances, Mr. Rodier's plan, as set forth in his pamphlet, which is certainly theoretically correct, ought to be tried by the authorities on a large scale. It would be easy to fence round a few thousand acres in one of the worst districts and see what effect will be produced by capturing the rabbits alive and killing only the females. Mr. Rodier tells us that his plan has succeeded well at Tambua Station, and there is every reason to suppose that it would succeed elsewhere if it were properly tried.

THE ROYAL HORTICULTURAL SOCIETY.[1]

FEW things have been more gratifying to those "seriously" interested in horticulture than the great improvement that has taken place in the publications of the Royal Horticultural Society during the last few years. The Society has more than recovered from the disasters that befell it at South Kensington. The present year is not yet completed, but already more than one thousand new fellows have been elected. There is every probability that the approaching centenary will be fittingly celebrated by the erection of proper offices, including an exhibition hall and accommodation for the excellent Lindley Library. This latter is the property of certain trustees, but is inseparable from the Society so long as it exists as a corporate body in or near the metropolis.

One potent reason for the phenomenal success which has of late years distinguished the Society is to be found in the zeal, energy and organising faculty of the secretary. In no respect are these qualities more conspicuously illustrated than by the publications of the Society edited by him.

The papers contributed to the *Journal* have almost always been good of their kind, but they were published at irregular, often very long, intervals, so that interest in them flagged or disappeared entirely.

Under the editorship of the present secretary, the quality of the *Journal* has been more than maintained, whilst comparative regularity of publication has been ensured; so that those fellows whose distant residence precludes them from availing themselves to the full of their privileges may yet be assured that in the *Journal*, as now issued, they have a full equivalent for their subscription, and, as far as possible, are kept abreast of the proceedings at headquarters.

The current number shows an improvement on its predecessors in the fact that a larger infusion of original illustrations has been vouchsafed. Among these we may mention the three coloured plates illustrative of several of the more common fungi which attack garden plants. The article on which these plates confer additional value is the production of Dr. M. C. Cooke, and we are glad to see it is marked "to be continued," for a more complete list of this kind than any that has yet appeared is greatly wanted by gardeners. Another paper illustrated by original half-tone blocks is that on "plant communities" by Prof. Carr, of Nottingham; at least we are not so familiar with them as with the numerous cuts which have done duty before in the various horticultural journals.

During the last year or two, a very useful addition has been made to the Society's records in the shape of short abstracts from current horticultural literature relating to the garden and its inhabitants. These are supplied by a goodly number of trained experts, and when experience has taught them a due sense of proportion and a more rigid selection of what is appropriate to a horticultural journal, their value will be even greater than it is now. This portion of the volume will require the greatest care in indexing, as without a comprehensive index reference will be greatly hampered. The contents are so varied that further detailed comment is impracticable. It must suffice to say that all classes of horticulturists, practical, scientific, æsthetic or amateur, will find something to interest them in these pages.

[1] *The Journal of the Royal Horticultural Society* (September, 1902). Edited by the Rev. W. Wilks, M.A., Secretary.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The resolution, "That candidates shall not be required to offer both Greek and Latin in the examination in stated subjects in Responsions," submitted to Congregation on Tuesday, was lost by 189 votes to 166. If the resolution had been carried, a proposal would have been brought forward on November 18, "That all candidates shall be expected to pass in two out of the four following languages:—Greek, Latin, French and German, one of the two being either Greek or Latin." By the decision of Congregation on Tuesday, Greek remains a compulsory subject at Responsions for all candidates; but the subject may be brought up again by a proposal to exempt candidates for honours in certain of the final schools from the compulsion of Greek.

Mr. George Herbert Grosvenor, B.A., New College, has been appointed to the biological scholarship at Naples for the year 1902–3.

THE late Colonel Walter Montgomerie Neilson, who was the son of the inventor of the hot-blast as applied to iron-smelting, and who, in a sense, was the founder of the locomotive trade in the Glasgow district, has made a bequest of 500*l.* in memory of his father, Mr. James Beaumont Neilson, to the Glasgow and West of Scotland Technical College, for the establishment of a gold medal and prize to be awarded each year to the best student of the College completing his course of study of three years for the diploma in mechanical engineering. The medal and prize are to continue the name of, and the invention by, Beaumont Neilson. The medal will be of the value of 10*l.*, and the prize will consist of books.

DR. G. R. PARKIN, the organising agent for the trustees of the Rhodes scholarships, is at present in Oxford to consult with the University and college authorities before proceeding to frame, for the approval of the trustees, a scheme for the election of the scholars. Dr. Parkin states that according to their size, each of the colleges seems prepared to take from two to five of the Rhodes scholars every year. This would give to the smaller colleges six in all for the three years' scholarship, and to the larger colleges about fifteen, when the plan is in full operation. The first year the bequest comes into operation there will be elected probably between seventy and seventy-five scholars, the same number for the second year, for the third year about thirty, and in subsequent years the same proportion will be maintained.

IN the course of an address delivered at the Liverpool School of Science on Saturday last, the Bishop of Liverpool remarked that the time had passed for ever when Great Britain stood first and the other nations of the world nowhere. There was great need for energy and exertion, and great care must be taken to develop on educational lines as fast as possible. Technical schools were meeting a real national need and helping to preserve the greatness of the Empire. They were bringing British science and industry together, and in future they would find that science would transfigure industry, and industry would make science more practical. But what were first needed were the unification of education and the full sympathy and cooperation of employer and employed, in which respect foreigners were somewhat ahead of us.

M. BORIS WEINBERG, of the University of Odessa, has recently completed an interesting inquiry into the provisions for the practical study of science made in 206 laboratories in connection with colleges in Europe, America and Australia. In March, 1900, M. Weinberg sent a circular letter to the directors of all physical, mechanical, electrotechnical and chemico-physical laboratories mentioned in the "Minerva Jahrbuch," asking for information as to the number of demonstrators teaching in the laboratories in 1900 and in previous years so far back as 1865, the number of students in the same years, the smallest number of students working at the same time in the laboratory, the hours devoted to practical work by each student during a week, and many similar points. His results are now published, and deal with typical university colleges, medical schools, technical colleges, &c., of the countries of Europe, of the United States and of Australia. The most valuable part of the information brought together in the pamphlet is the careful

analysis of the courses of study in physics in the different institutions from which data were received. In his circular to laboratory directors, M. Weinberg tabulated some 910 typical practical exercises in physics and requested that those worked in the laboratories might be underlined. It has thus been possible to institute an instructive comparison between the methods of different countries. About four hundred physical laboratories, having five hundred professors and eight hundred demonstrators or assistants, are recorded for the whole of the institutions for higher education in the world. In about one-fifth of these, practical work in physical manipulations is not carried on; in the rest, there are about 25,000 students who pass eight hours a week in the laboratories during three semesters. In these four hundred hours passed in the laboratory a student, on the average, performs sixty different experiments, or about two-thirds of the work for which the laboratory makes provision.

SCIENTIFIC SERIALS.

American Journal of Science, October.—An experimental investigation into the existence of free ions in aqueous solutions of electrolytes, by Julius Olsen. The well-known experiment of Ostwald and Nernst, which has been held to prove experimentally the existence of ions in solution, is criticised, and it is held that the conclusion arrived at does not necessarily follow, and that further proof is needed. Experiments are described which show that an electrolyte which has never been acted upon by a current behaves as if it contained particles charged with electricity which are free to move, and these particles have not been produced by a current. This corresponds to the definition of free ions.—On the solution of problems in crystallography by means of graphical methods, based upon spherical and plane trigonometry, by S. L. Penfield. It is shown that with the addition of certain stereographic scales and protractors to a set of ordinary drawing instruments, the lengthy calculations usual in determining the crystallographic constants can be avoided or, as an alternative, checked. Several illustrated examples of the mode of application of this method are given.—The estimation of bromic acid by the direct action of arsenious acid, by F. A. Gooch and J. C. Blake. It is shown that bromates may be satisfactorily estimated by the direct action of arsenious acid, the few apparent discrepancies which were found being traced to the presence of chlorate as an impurity in the bromate.—Solubilities of some carbon compounds, the densities of their solutions, by Clarence L. Speyers. Seven or eight carbon compounds of different types were examined in various solvents, including water, methyl, ethyl and propyl alcohols, chloroform and toluene. The results are compared with those calculated from Schroeder's formula, but the agreement is not good.

Transactions of the American Mathematical Society.—Vol. iii. No. 3 (July).—L. E. Dickson, on the group defined for any given field by the multiplication table of any given finite group. The subject of this paper is much the same as that of Burnside's in *Proc.* L.M.S. xxix.; the results, however, are obtained by a different method, which does not involve the theory of continuous groups. The paper illustrates the importance of Frobenius's discovery of the group determinant. Two examples are given.—O. Stolz, postscript to a previous article on rectification of curves. A comparison is made with Jordan's treatment of the same theory.—O. Bolza, proof of the sufficiency of Jacobi's condition for a permanent sign of the second variation in the so-called isoperimetric problems.—H. E. Hawkes, on hypercomplex number systems. The author develops the methods of Peirce, and shows that they give an enumeration of all systems in less than six units which have moduli in more than one idempotent unit. The systems for five units with two idempotent units are worked out in detail. A discussion of nilpotent systems follows.—W. B. Fite, on metabelian groups.—L. P. Eisenhart, on conjugate rectilinear congruences.—D. N. Lehmer, constructive theory of the unicursal plane cubic by synthetic methods.—L. E. Dickson, on the groups of Steiner in problems of contact (continued from the January number).

Bulletin of the American Mathematical Society (2) ix., No. 1 (October).—O. Bolza, examples in the calculus of variations.—E. R. Hadrick, on the sufficient conditions in the calculus of variations. A convenient summary, based on lectures by Hilbert.—E. B. Wilson, reviews of recent books on mechanics (Föppl, Volkmann, Picard).—E. V. Huntington, on a new edition of Stolz's "Allgemeine Arithmetik," with an account of Peano's definition of number.—E. J. Wilczynski, an obituary notice of Fuchs.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 31.—Prof. S. P. Thompson, president, in the chair.—A paper on the existence of a relationship between the spectra of some elements and the squares of their atomic weights, by Dr. W. M. Watts, was read by Prof. Everett. The author has detected two kinds of relation between the spectra of some allied elements. In the first kind, which is illustrated by comparisons between zinc, cadmium and mercury, and also between gallium and indium, the differences between the oscillation frequencies of certain lines of one element are to the differences between the oscillation frequencies of the corresponding lines of another as the squares of their atomic weights. In the second kind, the relation is not between two, but between three spectra, and is illustrated by the trio potassium, rubidium and cæsium, as well as by the trio calcium, strontium and barium. The element of greater atomic weight has the smaller frequency, and, in comparing corresponding lines, one from each of the three spectra, the differences of frequency are proportional to the differences between the squares of the atomic weights. If each of the spectral lines in question is represented by a point the coordinates of which are "frequency" and "square of atomic weight," the three points which represent three corresponding spectral lines will lie on one straight line in the diagram, and these straight lines will be parallel for all the components of a given set of corresponding groups. When a similar mode of plotting by points is employed to exhibit the first kind of relation, the joins of corresponding points meet in a point which lies on the axis of frequencies, in other words, on the line of zero atomic weight. This relation was indicated by Ramage about a year ago as holding for corresponding doublets and triplets.—A paper on the size of atoms was read by Mr. H. V. Ridout. This investigation deals with the size of dissociated atoms, or ions, and the results obtained refer to a dissociated atom as the smallest quantity of matter which can take part in an electrolytic action. The element chosen is hydrogen, and the author concludes that, in round numbers, $114\frac{1}{2}$ million atoms are necessary to form a line one centimetre long. The method employed consists in finding a pair of spheres which would be charged by the quantity of electricity known to be necessary to electrolyse a given quantity of the body under examination—in this case water—to the known difference of potential of its ions. From this the size of the atoms is deduced, subject to certain assumptions enumerated and discussed in the paper. Lord Kelvin remarked that he had often concerned himself with the size of atoms, and pointed out that the value obtained by the author for the diameter of a hydrogen ion was almost exactly one-half of that which he had obtained for the diameter of a molecule of hydrogen. The fact, however, might be a coincidence. He had dealt with a sphere which would have the same effect as a double atom of hydrogen. While avoiding the assumption that atoms are hard and spherical, it was usual to treat them as such for purposes of calculation. The paper was an important one, but there were many assumptions which required looking into. Lord Kelvin said that, in dealing with the subject of atoms, it was necessary to consider the atoms of electricity. The atomic theory of electricity, now almost universally accepted, had been thought of by Faraday and Clerk-Maxwell and definitely proposed by Helmholtz. The atoms of electricity were very much smaller than the atoms of matter, and permeated freely through the spaces occupied by these greater atoms and also freely through space not occupied by them. An atom of electricity in the interior of an atom of matter experienced electric force towards the centre of the atom. We were forced to conclude that every kind of matter had electricity in it, and Lorenz had named electricity as the moving thing in atomic vibrations. If the electrons, or atoms of electricity, succeeded in getting out of the atoms of matter, they proceeded with the velocity of light and the body was radioactive. It was therefore not surprising that some bodies showed radioactive properties, but rather surprising that such properties were not shown by all forms of matter. Our knowledge of this subject,

which originated with the discovery of the Becquerel rays, had been greatly advanced by the experiments carried out at the Cavendish Laboratory, and he had no doubt that in the next two or three years much light would be thrown upon this important matter.—Prof H. L. Callendar exhibited some vacuum calorimeters. Three of the calorimeters were for the determination of the specific heat of mercury, water and steam respectively by the steady-flow method. The fourth was a vacuum-jacketed Bunsen calorimeter. Prof. Callendar gave some details of the instruments and described the method of using them.—Miss A. Everett exhibited some photographs of cross-sections of hollow pencils formed by oblique transmission through an annulus of a lens. The direct rays of an arc light were allowed to pass through an annulus of a convex lens tilted to an angle of 45° with their direction and placed at a distance of about twice its focal length from the arc. The photographic plate was placed at right angles to the beam, and a series of exposures was made at gradually increasing distances from the lens. Two series of photographs were shown, the first series from a plano-convex lens with one annulus and the second from a double convex lens with two annuli.

Zoological Society, November 4.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Dr. C. W. Andrews gave an account, illustrated by lantern slides, of the palæontological discoveries made by himself and Mr. H. J. L. Beadnell during their recent visit to the Fayum, Egypt.—A communication was read from Mr. R. Shelford dealing with the mimetic insects and spiders of Borneo and Singapore.—Mr. C. Tate Regan read a paper on the classification of the fishes of the suborder Plectognathi.—A communication from Lieut.-Colonel J. M. Fawcett contained notes on the transformations of the butterfly *Papilio dardanus* and the moth *Philampelus megaera*, and descriptions of two new species of moths under the names *Rabdosia clio* and *Dermaleipa daseia*.—Mr. Oldfield Thomas read a paper on the mammals collected by Mr. Edward Degen during his recent expedition to Lake Tsana, Abyssinia.—A communication was read from the Hon. Walter Rothschild, in which he stated his opinion that the elk described by Mr. Lydekker as *Alces bedfordiae* was, if not a valid species, a distinct subspecies, and not a variety as had been supposed by Mr. H. J. Elwes.

CAMBRIDGE.

Philosophical Society, October 27.—Prof. Macalister, president, in the chair.—A case of extreme visceral dislocation, with remarks on the functional interpretation of the agminated glands of the intestine, by Dr. E. Barclay-Smith.—Notes on the genus Liparis, by Mr. J. J. Lister. Among other points, attention was drawn to the difference between the conspicuous satiny-white colouring of the three species *Porthesia chrysorrhaea*, *P. auriflua* and *Liparis salicis* and the quiet buffs, browns and blacks of the other members of the family, conforming closely with their environment; and it was pointed out that there is a considerable body of evidence showing that the conspicuous species are noxious to other animals, both in the larval and adult state, by reason of the urticating properties of the hairs.—Notes on the anatomy of *Macrozamia heteromera*, by Miss A. Robertson.—Further experiments on radio-activity from rain, by Mr. C. T. R. Wilson. In a paper read before this Society on May 5, experiments were described which showed that a vessel, in which freshly fallen rain has been evaporated to dryness, shows radioactive properties lasting for a few hours only. Many samples of freshly fallen rain have since that date been tested both here and at Peebles, and all have shown this effect. The magnitude of the effect obtained from a given quantity of rain has nearly always been of the same order, whether the rain has consisted of large or small drops, and whether it has been collected by day or by night, at the beginning of a shower or after some hours of continuous heavy rainfall. Once, however, during a thunderstorm an abnormally large effect was obtained. The radio-activity is obtained equally well. whether the rain is boiled down in platinum or porcelain vessels. It is not destroyed by porcelain vessels. It is not destroyed by heating the vessel to dull redness; in this, as in other points, it resembles the induced radio-activity obtained on negatively charged wires. From 190 c.c. of rain a precipitate was obtained sufficiently radioactive to increase the ionisation within the testing vessel to about 100 times its normal value; to enter the vessel the rays had to penetrate aluminium about 0·00032 cm. in thickness. The intensity of the radio-activity falls to about one-fourth of its initial value in an hour, like that obtained by evaporation. Similar precipitates formed in tap-water or in rain-water that has stood for twenty-four hours are quite inactive.

MANCHESTER.

Literary and Philosophical Society, November 4.—Mr. Charles Bailey, president, in the chair.—Mr. Francis Jones read a paper on the action of alkalis on glass and on paraffin, in which he pointed out that, while it is generally acknowledged that alkalis in course of time act on glass, there is considerable difference of opinion among chemists as to whether this action interferes with the well-known test for carbon dioxide in air, generally known as Pettenkofer's, but which was first described by Dalton in a paper read before this Society in 1802. Solutions of lime, strontia and baryta of known strength were left in glass bottles at the ordinary temperature for several months, and the strength of each was ascertained from time to time. It was found that the lime water lost strength more rapidly than the others, and that baryta could be kept in glass bottles for a period of twenty months without suffering any material loss in strength. Similar solutions were left in contact with finely divided silica and with powdered glass, and again it was found that lime water acted on these bodies more rapidly than the other two. The action on glass bottles, however, is not so rapid as to prevent any three of these alkaline solutions being used for Pettenkofer's test. It has been suggested that bottles used for this test should be coated with paraffin wax to prevent the contact of the alkaline liquid with the glass, but the author shows that lime, strontia and baryta lose strength in contact with paraffin, the action of baryta being much more energetic than that of either lime or strontia. Some baryta solution in contact with paraffin for five months was very nearly neutral at the end of that period. Consequently, the storing of standard baryta solutions in paraffined bottles is quite inadmissible.—Sir W. H. Bailey exhibited the working model of the switchback centrifugal railway invented and made by Richard Roberts.—Mr. W. E. Hoyle exhibited some coloured photographic lantern slides prepared by the Sanger Shepherd process.

PARIS.

Academy of Sciences, November 3.—M. Bouquet de la Grye in the chair.—On two Trypanosomes of Transvaal cattle, by M. A. Laveran. Details are given of the mode of growth and multiplication of *Tr. Theileri*, the cause of the cattle disease known as Galziekte. Another Trypanosome, found by M. Theiler in the blood of an ox, is regarded by the author as a new species, to which the name of *Tr. transvaaliense* is given.—On the equality of the velocity of propagation of the X-rays and of light in air, by M. R. Blondlot. On the supposition that the velocities of the X-rays and the Hertzian waves are equal, it can be predicted that the reinforcing effect of an X-ray tube upon a spark discharge ought to pass through a maximum for a certain position of the tube with regard to the spark, and this conclusion has been confirmed by experiment. The same hypothesis allows of the calculation in advance of the displacements that the position of the tube corresponding to this maximum ought to undergo in consequence of changes in the conducting wires or in the detonator. This was also confirmed experimentally, one method giving for the ratio of the velocities 0·97 and the other 0·93. The whole of the experimental facts lead to the conclusion that the velocity of propagation of the X-rays is equal to that of the Hertzian waves or of light in air.—On some recent sunsets, by M. Perrotin. The recent sunset glows are compared with the similar ones in 1883, and the hypothesis of their volcanic origin is considered. It is pointed out that the phenomena occurred in the same month in both years, which would tend to suggest that their origin was rather due to meteorological conditions than to after effects of volcanic eruptions.—The analysis of nine specimens of air collected in the galleries of a coal mine, by M. Nestor Gréhaut. The carbonic acid was found to vary between 1·0 and 1·8 per cent., methane between 3·5 and 7·5 per cent., and oxygen between 16·1 and 18 per cent. Attention is drawn to the high percentage of marsh gas, which in three cases was present in sufficient quantity to form an explosive mixture.—On the monographic resolution of the triangle of position for a given latitude, by M. Maurice d'Ocagne.—On uniform transcendentals defined by differential equations of the second order, by M. R. Liouville.

—On the formation of liquid drops and the law of Tate, by MM. A. Leduc and P. Sacerdote. A reply to the criticisms of MM. P. A. Guye and L. Perrot.—Remarks on a recent note by M. Ponsot on the electromotive force of a thermoelectric couple, by M. H. Pellat.—On the electrical resistance of lead sulphide at very low temperatures, by M. Edmond van Aubel. The resistance of the lead sulphide was found to diminish as the temperature was lowered. The experiments were carried out over a range of temperature between the boiling point of liquid air and the ordinary temperature of the room. The results are not in accord with the previous work of Guinchant and Streintz. —On a chlorosulphate of aluminium, by M. A Recoura. The aluminium compound isolated proved to possess the formula $AlSO_4Cl,6H_2O$, analogous with the similar chromium previously described.—On a general method for the preparation of the metallic nitrides, by M. Guntz By heating various metallic chlorides with lithium nitride, several new nitrides have been obtained; among these are two new nitrides of iron having the composition Fe_3N_2 and FeN: chromic chloride gives CrN. By working with lithium hydride instead of the nitride, metallic hydrides are obtained, but in many cases the reaction is so violent that the hydrides formed are decomposed. The conditions necessary to prevent this decomposition are now being studied.—On barium ammonium and barium amide, by M. Mentrel. Barium ammonium is readily formed by the action of barium on ammonia at $-23°$ C., the dissociation pressures being measured for temperatures between $-63°$ and $28°$ C. Nitric oxide is absorbed by this substance at low temperatures, barium hyponitrite being formed; carbon monoxide is also absorbed under similar conditions, forming a new compound, barium carbonyl, $Ba(CO)_2$, a yellow, solid body which decomposes without explosion in contact with air, or on heating. Metallic barium, heated at 280° in a current of dry ammonia, gives barium amide.—On some products of the oxidation of aniline by atmospheric oxygen, by M. C. I. Istrati. By the prolonged action of air on boiling aniline, three new crystalline substances of high molecular weight and unknown constitution were obtained.—On a new albuminoid material extracted from maize, by MM. E. Donard and H. Labbé. The new substance, which is present in maize to the extent of about 4 per cent., and which is best extracted by boiling amyl alcohol, is given the name of maisine. It possesses properties which distinguish it from the albuminoid matters obtained from other cereals.—On the estimation of carbon monoxide and carbonic acid in vitiated air, by M. Ferdinand Jean. An application of the minimetric method to the examination of air, requiring no skilled manipulation in its use.—Researches on the budding of *Rhabdopleura Mormanni*, by MM. C. Vaney and A. Conté.—On the fibrillar continuity of the epithelial cells in the Nebalia, by M. Alphonse Labré.—On vital rhythm, by MM. Vaschide and Cl. Vurpas.

NEW SOUTH WALES.

Royal Society, September 3.—Prof. Warren, president, in the chair.—Languages of some native tribes of Queensland, New South Wales and Victoria, by Mr. R. H. Mathews. This paper dealt fully with the grammatical structure of the speech of the native tribes inhabiting the Murray River along the Victorian frontier, and stretching thence northerly through the central and western districts of New South Wales to the 29th parallel of latitude, and continuing onwards far into Queensland.—(1) Current papers, No. 7; (2) Meteorological notes, by Mr. H. C. Russell, C.M.G., F.R.S.—Meteoric dusts, New South Wales, by Prof Liversidge, F.R.S. The term meteoric dust is used because it is commonly applied to the materials forming the subject of this paper; it is not intended to state that the dusts are necessarily of cosmic or extra-terrestrial origin. The specimens described and exhibited were from Moruya (fell on December 15, 1880); from Uralla (fell on December 14, 1882); from near Broken Hill (fell 1896); from Menindie (fell on June 17, 1899); and Pambula (fell on October 5, 1899). Dust from the roof-beams, and mud from a covered cistern at the University and from the roof of the Observatory, Sydney, all three were collected in 1882. All the dusts are of a reddish colour except those from the University and Observatory, which are grey. The red dusts are mainly siliceous and argillaceous, and look as if they had come from dried-up water-holes; they contain a variety of organic and mineral matters such as might be expected from such a source, and in addition magnetite and metallic iron; the latter contains cobalt and nickel, which seems to indicate that the dusts contain some cosmic or extra-terrestria materials, part of which may have settled down and become mingled with the undoubted superficial terrestrial deposits, and part may have been derived directly from the atmosphere. The University and Observatory dusts also yielded magnetite and metallic iron containing cobalt and nickel, and the University dust yielded particles of gold; the Observatory dust has yet to be tested. The Moruya, Menindie and Barrier red dusts yielded particles of gold; the others have yet to be examined. Fuller information is given in the paper as to the constituents and chemical composition of the dusts, and analyses of volcanic and other dusts for comparison.—A rapid method of estimating lime, by Mr. F. B. Guthrie and Mr. C. R. Barker.

Linnean Society, August 27.—Mr. J. H. Maiden, president, in the chair.—On a new Cryptocarya from Lord Howe Island, by Mr. J. H. Maiden. The "black plum" of Lord Howe Island, the flowers of which have only recently been available, is shown to be new and described under the name *Cryptocarya Gregsoni*. It is also shown that an Elæocarpus occurs on the island, although the material at present available is insufficient to determine the species. Also that the Symplocos on the island, hitherto looked upon as *S. Stawelli*, is in reality new to science, and has been named *S. candelabrum* by Brand. Carl Mez, the monographer of the order Myrsinaceæ, has shown that there is no true Myrsine on the island, but that the genus Rapanea is represented by two species, *R. platystigma*, Mez (*Myrsine platystigma*, F.v.M.) and *R. myrtillina*, Mez, sp.n.—Life-histories of, and notes on, Australian Neuroptera, by Mr. W. W. Froggatt. One species of the family Panorpidæ (*Bitticus australis*, Klug) and twelve of the family Hemerobiidæ are treated of.—Some records of New South Wales mosses, by Mr. W. Forsyth. Eighty-one species or forms are noted. Of these, six forms are new, thirty-nine are additions to the known flora of the State, one is new for Australia, while the remainder are recorded from new or additional localities. The paper concludes with a list of thirty-three species collected in the neighbourhood of the Jenolan caves. — Census Muscorum Australiensium: a classified catalogue of the frondose mosses of Australia and Tasmania, collated from available publications and herbaria, by the Rev. Walter W. Watts and Thomas Whitelegge. Part i., comprising about 530 species.—The ulcer disease (black ophthalmia?) of rainbow trout, by Mr. R. Greig Smith. The ulcer disease of rainbow trout appears to be identical with the brook trout disease of American writers. The disease called black ophthalmia recently occurred at the same time as the ulcer disease in a tank of rainbow trout, but there is reason to believe that these two are not the same disease. From the ulcers, *Micrococcus pyogenes* was isolated. This produces somewhat similar lesions in mammals. The action of the micrococcus in trout appeared to be influenced by the unhealthy conditions to which the fishes had been subjected.

September 24.—Mr. J. H. Maiden, president, in the chair. — Australian fungi, new or unrecorded. Decades i.–ii., by Mr. D. McAlpine.—On a new species of Ardisia from New South Wales, by Mr. R. T. Baker.—Notes on Prosobranchiata. Part i. Lotorium, by Mr. H. Leighton Kesteven. The first portion of the paper is a discussion of the synonymy of the genus and family. The conclusions are in favour of the adoption of Montfort's name Lotorium for the genus, and Harris's Lotoriidæ for the family. The second part deals with the arrangement of the species of the genus.—The bacterial origin of the gums of the arabin group, by Mr. R. Greig Smith. (i) The soluble (arabin) wattle gums. A bacterium (*Bact. acaciae*, n. sp.) was found in pure culture in the tissues of *Acacia binervata* from which gum was exuding. In the laboratory it produced a gum which behaved to reagents, gave the same oxidation products and contained the same constituents, viz. arabinan and galactan, as the natural gum. This soluble gum, and probably all others of a similar nature, are therefore of bacterial origin, a circumstance which had been suggested by the irregular distribution of gum-bearing trees. (ii) The insoluble (metarabin) wattle gums. In company with *Bact. acaciae*, a bacterium (*Bact. metarabinum*, n. sp.) was separated from the bast of *Acacia penninervis* affected with gumming. In artificial culture it formed a gum which swelled with water like the metarabin gums. The gum gives the same reactions and contains the same arabinan-galactan complex as the natural gum. The metarabin is, therefore, the product of this organism.—Revision of the

Australian Curculionidæ belonging to the subfamily Cryptorhynchides, by Mr. Arthur M. Lea.—Descriptions of some new Araneidæ of New South Wales, No. 10, by Mr. W. J. Rainbow. Three new species, referable to the genera Storena, Araneus and Stephanopsis, are described and figured.—Notes on some New South Wales hepatics, by the Rev. W. Walter Watts. Twenty-three species are recorded, the majority of them collected on the Richmond and Brunswick rivers.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1902, contains the following memoirs communicated to the Society :—

July 12 :—W. Voigt : Further contributions to the explanation of the properties of pleochroic crystals. H. Vöchting : On experimental anatomy (of plants).

July 26 :—F. Schmidt : The body-musculature of *Branchiobdella parasita.* W. Kaufmann : The electromagnetic mass of the electron. O. Wallach : Researches (xi.) from the University Chemical Laboratory of Göttingen—(1) on the isomerisation of cyclic hydrocarbons and ketones ; (2) on the transformation of cyclic ketones into bases of nitrogenous ring-systems. W. Voigt : New observations on magneto-optic phenomena in absorption bands.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 13.

MATHEMATICAL SOCIETY, at 5.30.—Address on the Infinite and the Infinitesimal in Mathematical Analysis : Dr. E. W. Hobson.—Ueber den Satz der Gleichheit der Basiswinkel im gleichschenkligen Dreieck : Dr. D. Hilbert.—The Summation of a Certain Series : Prof. A. C. Dixon.—Expansion by Means of Lamé's Functions : Prof. A. C. Dixon.—Sets of Intervals : W. H. Young.—Note on Unclosed Sets of Points defined as the Limits of a Sequence of Closed Sets of Points : W. H. Young.—Wave Propagation in Two Dimensions : Prof. H. Lamb.—The Continuation of Certain Fundamental Powers Series : Prof. M. J. M. Hill.—A Geodesic on a Spheroid and an Associated Ellipse : L. Crawford.—The Propagation of Light in a Uniaxal Crystal : Prof. A. W. Conway.—A New Connection between Legendre Functions and Bessel Functions : E. T. Whittaker.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presidential Address by Mr. James Swinburne.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Another Form of Micrometer for Measuring Star Positions : H. C Russell.—Ephemeris for Physical Observations of the Moon for 1903 : A. C. D. Crommelin.—Stereoscopic Pictures of Comet Perrine : Max Wolf.—On the Images Formed by a Parabolic Mirror, second paper—Influence on the Measurement and Reduction of a Photograph : H. C. Plummer.—Sur la Précision des Mesures Photographiques : M. Lœwy.—Herschel's Nebulous Regions compared with Photographs taken with the 20-inch Reflector and 5-inch Cooke Lens : Isaac Roberts.—*Possible papers :* On the Proper Motion of Bright Stars Relatively to Faint in the Zones near 30° North Declinations : H. H. Turner.—On a Standard Scale of "Seeing" : Percival Lowell.

PHYSICAL SOCIETY, at 5.—The Theory of the Aluminium Electrode : Dr. W. W. Tayler and J. K. H. Inglis.—A Determination of the Ratio of the Specific Heats at Constant Pressure and at Constant Volume for Air and Steam : W. Makower.

TUESDAY, NOVEMBER 18.

ROYAL STATISTICAL SOCIETY, at 5.30.—Annual Address by the President, Major P. G. Craigie, C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed :* Electric Tramways : C. Hopkinson, B. Hopkinson and E. Talbot.

MINERALOGICAL SOCIETY, at 8.—On some Swiss Minerals : Prof. Lewis.—On Proustite : Mr. Lamplugh.—On Seligmannite and Baumhauerite : Mr. Solly.

ZOOLOGICAL SOCIETY, at 8.30.—On some Pliocene Mammalian Remains from Concud, near Teruel, Spain : Dr. A. Smith Woodward, F.R.S.—On the Birth of an Indian Elephant in the Society's Menagerie : F. E. Beddard, F.R.S.—Note on the Cabul Markhor : R. Lydekker, F.R.S.

WEDNESDAY, NOVEMBER 19.

CHEMICAL SOCIETY, at 5.30.—The Dynamic Isomerism of Thiourea and Ammonium Thiocyanate : J. E. Reynolds and E. A. Werner.—Isomeric partially Racemic Salts containing Quinquevalent Nitrogen ; (1) Part VIII. : Resolution of the Hydrindamine Bromocamphor Sulphonates ; (2) Isomeric Compounds of the Type $NR_1R_2^{\prime}H_3$: F. S. Kipping.—The Synthesis of $\alpha\alpha$-Dimethylglutaric Acid, of β Hydroxy-$\alpha\alpha$-di-methylglutaric Acid, and of the Cis- and Trans- Modifications of $\alpha\alpha$-Dimethylglutaconic Acid : W. H. Perkin, jun., and Miss E. Smith.—A Reaction of some Phenolic Colouring Matters. Part II. : A. G. Perkin and C. R. Wilson.—The Vapour Pressures and Boiling Points of Mixed Liquids. Part II. : S. Young and Miss E. C. Fortey.—(1) The Vapour Pressures and Boiling Points of Mixed Liquids. Part III ; (2) Note on Mixtures of Constant Boiling Point : S. Young.—Note on the Condensation Points of the Thorium and Radium Emanations : E. Rutherford and F. Soddy.—The Oxime of Mesoxamide and some Allied Compounds. Part II. Disubstituted Derivatives : Miss M. A. Whiteley.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—English Climatology, 1881–1900 : F. Campbell Bayard.—The Rainfall of Dominica : C. V. Bellamy.

GEOLOGICAL SOCIETY, at 8.—The Semna Cataract or Rapid of the Nile ; a Study in River-erosion : John Ball.—Geological Notes on the North-West Provinces (Himalayan) of India : Francis J. Stephens.—Tin and Tourmaline : Donald A. MacAlister.

ROYAL MICROSCOPICAL SOCIETY, at 8.—An Electrical Method of taking Microscope Measurements : Dr. Philip E. Shaw.—Demonstration on the Microscope in Fossil Botany : Dr. D. H. Scott, F.R.S.—Demonstration on an Apparatus for obtaining Monochromatic Light with the Mixed Jet : Dr. Edmund J. Spitta.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Probable papers :*—Report on the Recent Eruption of the Soufrière in St. Vincent and on a Visit to Mont Pelée in Martinique : Dr. Tempest Anderson and Dr. J. S. Flett.—Contributions to a Theory of the Capillary Electrometer. II. On an Improved Form of Instrument : G. J. Burch, F.R.S.—On the Correlation of the Mental and Physical Characters in Man. Part II. : Dr. Alice Lee, Miss M. A. Lewenz and Prof. K. Pearson, F.R.S.

LINNEAN SOCIETY, at 8.—Digestion in Plants : Prof. Sydney H. Vines, F.R.S.—Relation of Histogenesis to Tissue-Morphology : A. G. Tansley.—Stelar Structure of Schizæa and other Ferns : L. A. Boodle.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Adjourned Discussion upon Captain C. C. Longridge's Paper on Oil Motor Cars of 1902.—And, *time permitting*, Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands : J. N. S. Williams.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—What is Climatic Disease : Lieut.-Col. A. M. Davies.

CONTENTS.

THURSDAY, NOVEMBER 20, 1902.

BERZELIUS AND WÖHLER.

Briefwechsel zwischen J. Berzelius und F. Wöhler. Im Auftrage der Konigl. Gesellschaft der Wissenschaften zu Göttingen. Mit einem Commentar von J. von Braun. Herausgegeben von O. Wallach. Two vols. Pp. xxii + 717 and pp. 743. (Leipzig : Wilhelm Engelmann, 1901.) Price 2*l.* net.

THE story of the origin of Wöhler's association with erzelius has been told by Wöhler himself in the *Berichte* of the German Chemical Society in one of the most charming autobiographical sketches which have ever enlivened the formal pages of a scientific periodical. Readers of the *Berichte*—and their number is legion—will recall the picture of the young graduate of twenty-three who, with the ardour of the zealous neophyte, had journeyed from the cloisters at Heidelberg to seek light and leading from the great high priest at Stockholm. How with a beating heart he stood before Berzelius's door and rang the bell. How it was opened by a well-clad, portly, vigorous-looking man—none other than Berzelius himself; and how he was led into the laboratory as in a dream, doubting if he was really in the classical place which was the object of his aspirations.

From that memorable meeting sprang a friendship which ended only with Wöhler's death. Berzelius died in 1848, but to the end of his days Wöhler continued to cherish the most affectionate feeling towards his teacher, exhibiting an almost filial piety in regard to his name and fame. He remained to the last what he was wont to sign himself—"Unveränderlich Ihr Wöhler."

Berzelius was an indefatigable letter-writer, and his correspondents were to be found in every country in which chemistry was cultivated. But to none did he unburden himself as he did to Wöhler. For nearly a quarter of a century—that is from 1824 to 1848—scarcely a month passed without an exchange of letters. Those from Berzelius were carefully preserved by Wöhler, who subsequently presented them, some hundreds in number, to the Swedish Academy of Sciences.

It is this correspondence which forms the subject-matter of the volumes before us. Its publication is due to the action of the Royal Society of Sciences of Göttingen, which has desired thereby to commemorate, in connection with the centenary of his birth, the long and valuable service which Wöhler rendered to that body as its secretary. Wöhler had stipulated that the letters from Berzelius which he deposited with the Swedish Academy should not be published before January 1, 1900. This injunction was, no doubt, expedient in view of the character of the letters. The period over which the correspondence extended was a time of stress and strain, not only in politics, but also in science and especially in the science of chemistry. When it began, the influence of Berzelius in the world of chemistry was supreme. Davy, it is true, still lived, but his intellectual activity was well-nigh spent and he was already showing signs of the obscure malady which occasioned his death in 1829. As the years flowed on, Berzelius was made conscious that his influence was waning—steadily undermined by the leaders of chemical thought in Germany and in France, by Liebig and Dumas and their respective followers, who, continually at war with one another, agreed only in disagreeing with Berzelius.

The secretary of the Swedish Academy was, however, a doughty antagonist; very tenacious of his convictions and somewhat insistent in his expression of them, as the pages of his *Jahresberichte* frequently testify. As might be expected, his letters to Wöhler give even more emphatic expression of his opinions, and when his feud with Liebeg culminated in an open breach, he is at no pains to conceal his sense of resentment and irritation. It is this circumstance that determined Wöhler to fix the end of the century as the time that the letters should first be made public—a time so remote from the period to which they relate as to render it reasonably certain that no pain would be occasioned by their publication. In this respect Wöhler was true to himself. He hated contention and was always ready to advise the lion to eat sugar, as he once said to Liebig. His own letters abundantly illustrate this disposition. They are delightful in their spontaneity and directness, in their sobriety of statement, their unfailing charity and the quiet, delicate humour by which they are constantly illumined. Berzelius evidently set considerable store by them, and they were preserved with no less care than his own. They were ultimately given by the Baroness Berzelius to the Stockholm Academy, and were by it placed at the disposal of the Göttingen Society. With a few exceptions, Berzelius's letters were written in Swedish, and have been rendered into German for the purpose of this work by Frau Prof. Schering, of Göttingen, the daughter of the Swedish Prof. Malmsten. Those from Wöhler have been arranged for publication by his daughter, Frl. Emilie Wöhler.

To the historian of chemistry, this correspondence is of singular value and interest, inasmuch as it stretches over the period which saw the rise of modern chemical theory. Throughout it are constant references to the ideas and hypotheses which gradually developed into the chemical doctrine of the middle part of the nineteenth century—of the period we associate with the names of Liebig and Wöhler, Magnus, Mitscherlich, Rose and Dumas. In some of the letters, we have accounts of discoveries and inventions which mark epochs, or points of departure, in chemical progress. Thus in one of the letters Wöhler describes in detail Liebig's newly-invented method of organic analysis, with sketches of the potash-bulbs, of the mode of making the india-rubber joints and of the charcoal furnace or chauffer. Berzelius was, as is evident from his reply, greatly impressed with the value and importance of the new method, and his genius for manipulative chemistry was immediately exercised in suggestions which he trusts may be improvements. Wöhler also sent to Stockholm one of the earliest accounts of Will and Varrentrapp's method of determining nitrogen. Indeed, we frequently meet with accounts, occasionally illustrated by rough sketches, of manipulative methods and pieces of apparatus which are nowadays to be met with in all laboratories. We have accounts sometimes from the discoverers themselves of metaphosphoric acid, thoria, hippuric acid, vanadium, tellurium, chloroform, chloral; of the isolation of

aluminium; of the synthesis of urea and the mode of preparation of a host of substances, organic and inorganic, of which the times were fertile. Very interesting and instructive, too, are the references made by the correspondents to the work of their contemporaries. Thus Berzelius keeps Wöhler informed of what Mosander is doing, and of the researches of his pupils Dahlström, Sefström, Mitscherlich, Magnus and Johnston; whilst Wöhler in his turn tells, for example, what he knows of Liebig's work, of the progress of Bunsen's investigation of the fuming liquor of Cadet, or sends short notices of what the Göttingen students, under the stimulus of his direction, are turning out.

Wöhler was an excellent draughtsman. Some of his drawings are as amusing as they are clever. Not less excellent are his verbal sketches, as may be seen in the admirable descriptions he sends Berzelius of his experiences of Paris and of the French chemists of the day—what Berzelius styles "die amüsanten Plaudereien ueber die Babylonischen Chemiker"—Gay-Lussac, Thénard, Dulong, Ampère, Chevreul, Robiquet, Bussy, Boussingault, Dumas, Pelouze. He thus, for example, describes Ampère:—

"Ampère. Ein Original wie es wohl wenige mehr gibt. Ein ziemlich grosser alter Mann, vom Alter etwas gebückt mit dicker hängender Unterlippe, ziemlich zahnlos, mit hervorstehenden, stier blickenden Augen, eine Perrücke, die hier und da den Kahlkopf durchblicken lässt, gekleidet in schwarzem Frack, der sehr alt und abgeschabt ist, und die Wäsche stets braun von Schnupftabak, den er in zwei Dosen mit sich führt. Dessen ungeachtet war mir dieser Mann einer der merkwürdigsten und respectabelsten. Den Neckereien und Witzen, die er von den anderen alten, namentlich von Arago und Thénard, zu erdulden hat, entgegnet er mit einer grossen Gutmüthigkeit und nicht selten mit komischem Witz. Nichts verdriest ihn, und er bleibt stets in demselben guten Humor. Er ist ohne Zweifel einer der tiefsten speculativen Köpfe und scheint eine ungeheuere allgemeine Gelehrsamkeit zu besitzen. Er ist selbst in den neuesten chemischen Entdeckungen ganz im Detail zu Haus."

Equally interesting, and no less characteristic, is his account of Dumas, whom he styles "der fleissigste und geistvollste der jüngeren franz. Chemiker." His description of the "kleiner, magerer Kerl" is too long to quote here, but it caused Berzelius to say in reply, "Ich möchte unendlich gern Dumas Bekanntschaft machen."

Had space permitted, we should have liked to have given a number of extracts in order to illustrate the wealth of information of historical value which is scattered throughout this correspondence. There is not a dull page in the two volumes. At times, indeed, the letters are of the greatest interest, and not unfrequently they are most amusing.

They have been carefully edited, and the commentary and foot-notes supplied by Dr. von Braun serve to elucidate many points which would otherwise be obscure. We congratulate Prof. Wallach on the production of a work which is a striking monument to the genius of two men of whom it may be said, as Liebig said of his own friendship with one of them, that now they are dead and mouldering, the ties which united them in life still hold them together in the memory of men as faithful workers who zealously laboured in the same field, linked together in the closest friendship. T. E. T.

A BIOLOGICAL PHILOSOPHER.

Die organischen Regulationen. Vorbereitungen zu einer Theorie des Lebens. Von Hans Driesch. Pp. xv+228. (Leipzig: Engelmann, 1901.) Price 3s. 6d. net.

DR. HANS DRIESCH is well known for his experimental contributions to "developmental mechanics" and as a man of strenuous "begriffskritische Thätigkeit." He is the author of a number of essays which give their readers good exercise in intellectual mastication, and the book before us is another hard nut. We are in entire sympathy with his endeavour after an exact criticism of biological categories and with his ideal of a "truly scientific biology" with thought-out and unified formulæ; we suspect there is some justification for his reproach that there is far too little "reines Nachdenken" in the tents of the biologists; and we share his hope that "in the future the naturalist will be more of a philosopher and the philosopher more of a naturalist"; but, to be frank, we wish that the author, who writes much, could see his way to write a little more clearly. We do not, of course, expect a philosophical criticism of biological categories to read like a novel, but we object to a book where the difficulty of individual sentences intermittently inhibits us in our effort to appreciate the general argument. It may be that biologists do not quite realise how much they are losing by not reading Driesch's essays; but does Driesch realise how much he is losing by ignoring the limitations of human faculty and of a busy biologist's leisure? We have to rub up our mathematics to understand Karl Pearson, we have to learn statistical methods, we are reminded that "nemo physiologus nisi psychologus," we have perforce to be palæontological, our attention to chemistry and physics is essential, we are told that some acquaintance with crystallography, mechanics and meteorology will not be amiss, and so on. Thus a book which demands for its due appreciation no small amount of familiarity with philosophical terms and methods comes almost as the last straw to break the back which mis-education has weakened. We remember, however, that Driesch's essay is intended for philosophers as well as for biologists, and we hope that the former will discover a limpid stream in what seems to us a rather turbid flow, broken here and there by luminous rapid rushes.

The work before us is one of a series of "studies" ("Vorbereitungen") for a theory of life. It deals with "organic regulations," *i.e.* with those vital phenomena which may be roughly compared to the action of a safety-valve in a steam-engine—a compensatory action annulling the disturbing factor and restoring equilibrium. It does not, however, include those coordinated locomotor regulations which we call instinctive adjustments, or those which occur after extirpation-experiments on central nerve-organs. The author has abundant material without these. In studying "organic regulations," which he does with abundance of concrete instances, the author has had a two-fold aim—(*a*) that of giving impulse to research by showing in the strong light of his criticism the gaps in the scientific structure, and (*b*) of advancing a step or two towards "a truly scientific biology." This improved biology will have its dominant concepts more thoroughly thought out and more adequately harmonised,

and it will give prominence to what is, after all, the essential feature in life, the feature studied in Driesch's "Regulatorik"—a supplement to "Organisatorik"! As this scientific biology progresses, a recognition of the need for a "dynamic teleology" will become plain, and everything will become clearer before the open secret of "the autonomy of vital processes." The plan of the book is clear. Part A. is devoted to a descriptive and critical exposition of facts, based especially on the work of Pfeffer and Goebel, Dieudonné and Herbst, and dealing with phenomena like those of immunity, functional and structural adaptations, regeneration, and so on. Part B. includes a definition of the concept of "regulation," a classification of "regulations," an analysis of the process of regulation and an exposition of the two lines of argument which lead to a recognition of the autonomy of vital processes. Part iii. is more technically philosophical, dealing with "Denknothwendigkeit," "Causalität," &c. —"den reinen Erkenntnisskritikern empfohlen."

Let us try in more detail to illustrate the drift of this difficult book. Pfeffer has shown that certain fungi, supplied simultaneously with several organic substances, almost always assimilate first that which has the greatest nutritive value, and go on to the second best only after they have exhausted the optimum. In scarcity of food and of oxygen, many living creatures illustrate an adaptive regulation of their metabolism. There is strong evidence in support of the conclusion that various living creatures can by the production of a specific antitoxin render themselves relatively immune to a specific poison. We have given three examples which may hint at what Driesch means by regulations in metabolism ("*Stoffwechselregulationen*").

Similarly, we all know that the CO_2-content of the blood has a regulative effect on the blood-pressure and on the respiratory movements, that cold weather has a regulative influence on the peripheral circulation which lessens the loss of heat, that plants show a regulative transpiratory response to altered conditions of humidity, that a fungus-cell will save itself from plasmolysis in a too-concentrated solution by the increased production of osmotically-active substances (acids), that our intestinal and renal cells behave not less effectively, and that, altogether apart from brain or eyes, as in the case of a decapitated Planarian, there are adaptive responses to light and other stimuli. These examples may serve to suggest what Driesch means by functional regulations ("*Energetische regulationen*").

It is well known that the leaves of the same kind of plant may have different mesophyll arrangement in different conditions, and that the new circumstances may be said to evoke their own corrective; that the structural adjustments of the same amphibious plant to thoroughly aquatic or to mainly terrestrial life are effective in both instances; and that many kinds of creatures, both animal and vegetable, adapt themselves to conditions of desiccation. These are a few simple examples of what Driesch means by regulative structural adaptations ("*Morphologische Anpassungen an Aüsseres*").

If the top of a conifer be destroyed, a dorso-ventrally disposed side branch may rise upright; if a crab's leg or a lizard's tail is lost, another may be made; a fragment of an animal, even of an embryo, may regrow the whole; a Hydra's tentacles may, in case of need, be, as it were, resmelted into body-substance; the lost lens of a newt may be replaced by adventitious growth from the iris. In short, the author discusses the whole subject of regeneration (recrescence and reparation), and finds therein abundant evidence of "regulation" ("*Restitutionen oder Wiederherstellungsregulationen*").

The four German phrases noted above in italics are the titles of the first four chapters of the book, but we have not been able to give more than a hint of the breadth of the author's survey of facts. We would in particular direct attention to the valuable essay on regeneration included in chapter iv.

Part A. is relatively plain sailing, for there we are dealing with more or less familiar facts, but in Part B.—the theoretischer Theil—we soon get into rough water. There are many sentences which we cannot even pretend to understand. We are first supplied with a definition of the concept "regulation."

"A regulation is a process, or a change in a process, occurring in a living organism whereby some disturbance of its previous 'normal' condition is wholly or partially, directly or indirectly, compensated, and the 'normal' condition, or at least an approximation to it, restored."

By an abstraction, which, if we understand it aright, seems only verbal, Driesch distinguishes two chief kinds of regulations—organisational and adaptive; the former restore disturbed organisation, the latter restore disturbed adaptiveness. The author restores our confidence, however, by admitting that organisation and adaptation interpenetrate one another ("durchdringen sich"). Then follows an elaborate classified catalogue of "regulations."

We have read with interest and instruction the chapter on the course of a regulative process.

"The primary stimulus in regulations consists in a removal of parts or in a disturbance of function. It may coincide locally with the effect, or it may affect the organism quite generally, in which case the localisation of the effect in relation to that of the stimulus is 'specificirt,' or it may have a localisation other than that of the effect. In the last case, mediations ('Vermittelungen') of the primary stimulus become necessary, which sometimes perhaps express themselves materially ('stofflich'), but usually operate in a quite unknown manner. They thus produce the secondary or true stimulus, while in the other cases of relation between localisation of stimulus and localisation of regulation the primary stimulus was also the true one. Regulations, whether functional or formative, presuppose secondary prospective potencies, in contrast to the primary potencies, which form the basis of the normal series of occurrences ('Geschehen'). In the diversity of the specific distribution and specific content of these potencies, we find, at the same time, the limitations of the regulative process ('Geschehen'); since every regulative process is at the same time a reaction-process, its 'specificity' has at the same time the general physiological and morphological characteristics of a reaction-process; but it has besides special teleological characteristics always of a particular kind. The time at which a regulation begins to operate we call the 'Regulationsmoment.'"

We have tried to translate this "Rückblick" on the analysis of regulation-processes, and we must apologise for the awkwardness of our translation. We hope, however, that it will suggest the luminosity of Hans Driesch's

writings and the absurdly easy-going way in which many physiologists deal with that adaptiveness of response which is the very essence of life.

The kernel of the book is to be found in chapters vi. and vii. of the second part, but the kernel is surrounded by a hard stone. These two chapters (which Driesch says "ich ganz besonders als mein Eigenthum ansehe") contain an analytic discussion of "form-regulations," an excursus on the problem of heredity and an exposition of the two proofs of the autonomy of vital processes Evidences of the falsity of Weismann's theory of development and theory of heredity—both of which Driesch condemns as hopelessly materialistic—are thrown in. The differentiation of harmoniously-equipotential systems is the one foundation of "vitalism"; the existence and genesis of equipotential systems with complex potencies is the other. Whether we study the development of a sea-urchin ovum or the growth of a Tubularian fragment, or regeneration in Planarians, or the potencies of cambium, we are brought face to face with regulative phenomena which put the most elaborate "machine-theory" of life out of court and lead us to recognise "the autonomy of vital processes." So far as we understand, it simply comes to this, that the formulæ of chemistry and physics, as at present conceived, seem quite inadequate for the scientific interpretation of the facts of life.

J. ARTHUR THOMSON.

AN INDIAN POCKET-FLORA.

Forest Flora of the School Circle, N.-W.P. Being a Descriptive List of the Indigenous Woody Plants of the Saharanpur and Dehra Dún Districts and the Adjoining Portion of the Tehri-Garhwal State in the North-Western Provinces, with Analyses. Compiled for the Use of the Students of the Imperial Forest School, Dehra Dún, by Upendranath Kanjilal, Extra-Assistant Conservator of Forests. (Calcutta: Office of the Superintendent of Government Printing, India, 1901.) Price 2*s*.

"I BELIEVE this to be the first botanical work of any importance which has ever been prepared by a native of India, and the Imperial Forest School may well be proud of having educated at least one native gentleman who has taken up botany as a study and botanical work as a labour of love." So writes Mr. J. S. Gamble in his introduction to this useful pocket-flora, which is designed for the use of Indian students of forestry.

Following upon this introduction, in succession are the author's preface, a brief glossary of botanical terms, a general analytical table of the Phanerogamia, an analytical key to the natural orders, accounts of the natural orders, with analytical keys to the genera and species, and descriptions of the latter, and, finally, indices to the European, vernacular and botanical names.

Even with the great aid of Sir Joseph Hooker's "Flora of British India" and Sir Dietrich Brandis's "Forest Flora of the North-West Province," it was no light undertaking to prepare a pocket-flora containing the required information. The author may, however, be congratulated upon his execution of the task.

The greatest difficulty in compiling this work was, doubtless, to select the subject-matter in such a manner as to keep the book small in size, yet devoid of vagueness. The author has elected to give rather full descriptions of the species, even including their vernacular names, habitats, habits, timber structure, uses, times of flowering, fruiting and leaf-shedding. The compression, and hence uncertainty, has therefore fallen upon the steps leading to the determination of the species, and particularly upon the glossary and analytical keys. The result is that the work, though extremely useful as a pocket reminder and aid to students (for whom it is intended), and for others possessing other guides, could not be easily employed by a novice or amateur for the determination of species.

The glossary, in addition to being somewhat too compressed, is occasionally somewhat obsolete, so that some of the definitions, for instance "cone," "endosperm," "lenticel," "moniliform," "prickle," "symmetrical," are scarcely satisfactory. The term "gregarious," though frequently used in the book, is not explained. In regard to this term, its continued use in botanical works is somewhat unfortunate when the more accurate term "social" is available.

The very compressed table showing the general scheme of classification is disfigured by one unnecessary and serious error; it divides flowering plants into Monocotyledons and Dicotyledons, and the latter again into Angiosperms and Gymnosperms!

In the key to the natural orders, the diagnostic characters given evidently refer in particular to the representatives in the flora described; for instance, the features given in reference to the Dipterocarpaceæ are, that they belong to the Polypetalæ, Thalamifloræ, and possess a valvate, irregular calyx adnate to the ovary and enlarged in the fruit; again, the Tiliaceæ are distinguished from the Sterculiaceæ by the free condition of their calyx. It is in this analytical table that some additions would be especially useful, especially such as facilitate identification in the absence of fruits.

Similar additions might be made in the analytical keys to genera and species. To take a specific case, the seven genera of Coniferæ—Taxus, Cupressus, Juniperus, Pinus, Cedrus, Picea, Abies—are distinguished from one another in this book primarily by the structure of their fruits. A novice having a specimen without fruits consequently could not take the first step towards identifying his plant. Yet it is very easy to give a brief key showing how to distinguish these seven genera by the arrangement and form of their leaves. In this particular instance, too, an especially good observer might well be puzzled by the distinction in the analytical key between Picea and Abies, the leaves of the former being described as acicular and multifarious, whilst those of the latter are said to be flat and bifarious.

As regards the get-up and printing of the book, great carelessness has been exhibited in the printing and possibly in the revision of proof; ugly curved lines of words and displaced letters occur, but misprints abound in glossary, tables, text, and in names of all kinds.

The defects of the book, therefore, are for the most part minor or matters of opinion, whereas its merits are great; and, as Mr. Gamble writes, "I am confident

that . . . this Flora will prove valuable to many successive classes of forest students and many successive forest officers whose duties may call them to the beautiful forests of the Dún and the splendid scenery of the adjoining Himalayan Mountains."

THE LAWS OF GEOGRAPHY.

Les Lois de la Géographie. 1er. Étude. Par Carlos de Mello. Pp. viii + 360. (Berlin: R. Friedländer und Sohn, 1902.) Price 10 marks.

SENHOR CARLOS DE MELLO, professor of geography at San Paulo, wields the pen of a ready and fearless writer, for he prefaces his volume of 360 pages on the laws of geography with the statement that it was written in two months, and the regret that it is consequently neither so clear nor so full as it might otherwise have been. "A short bibliography," he says, "concludes the work"; but since the bibliography occupies 224 pp. and the rest of the work only 136, we are inclined to think that the fact could be better expressed otherwise. Dedicated in Portuguese, written in French, printed and published in Germany, it is evident that the "laws of geography" are superior to the trammels of nationality or language. We were, in fact, unfavourably impressed by the preface, and it required some effort to approach the text with an open mind. On reading the chapters it soon became apparent that, however hastily the book was written, its preparation had required and had received years of thought, and study and wide reading. Even in the minor details of correct transcription of foreign names and the titles of publications, quite exceptional care must have been taken, for we have rarely seen a book so full of detail equally free from typographical errors.

The first of the "laws of geography" to be discussed is the law of asymmetry. It is pointed out how rarely parallelism is found in the larger features of the globe, how invariably (except in the case of Africa) a continent occupies a non-central position on its continental block, and how the relief of the continent itself displays a conspicuous dissymmetry, as in the position of the great plateaus of America. From this principle a series of laws of contrasts and harmonies is deduced with much ingenuity and confirmed to a considerable extent by the citation of examples. But even by the device of adopting asymmetry instead of symmetry as the standard of reference, it is impossible to avoid exceptions and contradictions. For example, in the "law of contrasts" which declares that the northern continents extend in the direction of the parallels and the southern continents in the direction of the meridians, the anomalous case of Australia is passed over without remark. We cannot help feeling that the author may possibly hold too precise and mathematical a view of symmetry in regard to the great features of the Earth's crust. It seems to us that broad features should be looked at broadly, and that on doing so the Earth's surface exhibits a rough symmetry in the alternation of height and hollow and the interlocking of ocean and continent. To a closer view, of course, the roughness appears more remarkable than the symmetry, but we have a suspicion that the symmetry is there as a dominant fact and the asymmetry only as a detail. We are by no means sure, however, that the author has not started with the idea of the symmetry of terrestrial features as self-evident, and therefore devotes his whole attention to the rectification of the broad principle in details.

Part ii. deals with the laws of mutual dependence of terrestrial forms, and considers the cases of the relation of rivers to valleys and of continents to oceans. It presents a number of relationships arrived at by many authors whose works were often separated by considerable intervals of time. Some of these have been accepted and incorporated in current views, others have been passed over and forgotten. We have not space to refer critically to these, or to inquire how far they agree with or contradict the recent systematic discussion of the relation of rivers to their valleys which has culminated in the geographical cycle of Prof. Davis; but we cannot let pass the opportunity of reviewing this thoughtful summary of a part of geographical theory without inquiring why it is that so much of the work of geographical theorists has passed unproductively into oblivion. The reason may perhaps be that an original mind devoted to purely geographical questions has only arisen at long intervals; the work of the predecessor has been forgotten or absorbed as a detail in other sciences before the successor has made himself heard. It may be that this is due to the absence from geography of the numerous less original workers who are attracted to the study of other sciences by prospects of gain, and, while unable to advance the science themselves, at least hand on the torch without extinction.

Whether this be so or not, the fact is beyond dispute that geography has not made the progress that it should have done; and, more particularly in this country, the geographer as such is scarcely recognised. Geographical questions have so frequently been treated as incidents in the course of geological, botanical, zoological or historical investigations that even the scientific world hesitates to accept geography as a subject deserving of the whole attention of a competent man. There are signs of improvement in this respect, it is true, and any improvement is matter for satisfaction. There is room for many books of the type of Prof. de Mello's, and it would be well if such books commanded many readers. The sympathetic attitude of the ancient universities to geography is a gratifying and hopeful circumstance, almost compensating for the inadequate or even retrograde steps of the newer academic centres.

H. R. M.

OUR BOOK SHELF.

The Elements of Electrical Engineering. A First Year's Course for Students. By Tyson Sewell, A.I.E.E. Pp. xi + 332. (London: Crosby Lockwood and Son, 1902.) Price 7*s.* 6*d.* net.

THIS book, which is based upon courses of lectures delivered by the author, is primarily designed for students attending evening or other courses at the polytechnics. The course of lectures is more or less complete in itself, the necessary elementary theory being by no means neglected; the author, indeed, advises students to take a concurrent course in the scientific side of the subject, but such as are unfortunately unable to spare the necessary time will not, we think, find much in this book

which is beyond their comprehension. Undoubtedly, for a thorough training in electrical engineering the practical and theoretical sides of the subject must receive equal attention, but not all students can attend institutions where this is to be obtained. Many have of necessity to be satisfied with some sort of compromise, and one welcomes a book which is sound in its treatment and is admirably calculated to give such students the knowledge and information they most require.

Selection of some sort, when dealing with so large a subject, is of course necessary; the author has, we think, made a wise choice in the branches with which he deals and in the manner in which he treats them. These include, in addition to the general principles underlying the subject, batteries, accumulators, measuring instruments and supply meters, arc and incandescent lamps, and the continuous-current dynamo and motor. Particular apparatus is only described when it illustrates the general principles. Perhaps in a few instances there is a little too much detail, as, for example, in the description of the recording mechanisms used in meters. We would gladly see some of this matter omitted, and such branches as telegraphy, telephony and electro-chemistry treated on broad lines instead. Mr. Sewell has the power of clear exposition, and has succeeded well in avoiding too mathematical treatment; the illustrations and diagrams are excellent. M. S.

The Force of Mind: or, the Mental Factor in Medicine. By A. T. Schofield, M.D., M.R.C.S., &c. Pp. xiv + 309. (London: J. and A. Churchill, 1902.) Price 5s. net.

IN this book, which is written for medical practitioners, Dr. Schofield appeals for a fuller recognition of the influence of the "mind" in causing and in curing disease of the body, and urges medical men to work for the reclamation of those waste and unmapped regions in which the religious fanatic and the quack doctor have hitherto been allowed to reign, occasionally producing, among much that is harmful, remarkable cures. He would have the subject taught and studied in the hospitals and great medical schools as a part of the regular curriculum of every medical student. There can be no doubt that the reforms advocated are much needed and that Dr. Schofield performs a useful service in thus pointing out the weak and neglected side of modern medicine. The author supports his contentions with many quotations from high authorities, both ancient and modern, and by the citation of numerous cases, and gives from his own experience many practical hints that should be valuable to practitioners. From the point of view of the psychologist, the book is vitiated throughout by the insistence upon the part supposed to be played by "the unconscious mind." This seems to be a figment similar in function to von Hartmann's "unconscious," *i.e.* it is a hypothetical agent to the activity of which is assigned all that is obscure and difficult of explanation in the workings of the nervous system. It is a radically vicious hypothesis because it is one that tends to baffle rather than to quicken the impulse to research. We are told that the phrase is not used merely to cover the more complex workings of the nervous system that are not accompanied by consciousness, and no reasons are assigned for rejecting this, which may now be called the generally accepted and intelligible view of the matter. The author seeks to support his position by quoting Dr. Bastian's plea, "Let us make mind include all unconscious nerve actions," and in so doing reveals the dire confusion of his own thoughts on this subject. He good-naturedly pokes fun at those who objectify "Nature" as a healing agent and then commits the same error, replacing "Nature" by the *vis medicatrix naturae*, which he identifies with the unconscious mind, and thus commits himself to the somewhat absurd dogma that such remedial processes as compensatory hypertrophy of the heart and phagocytosis are manifestations of the power of "the unconscious mind." Unless it can be shown, as at present it cannot be, that nervous activities and conscious processes together are inadequate to the explanation of all the facts of our mental life, the assumption of a third mysterious agent, call it "the unconscious mind" or "subconsciousness" or what you will, is much to be deprecated. W. McD.

Introductory Chemistry for Intermediate Schools. By Lionel M. Jones, B.Sc., A.R.C.Sc.(Lond.) Pp. vii + 195. (London: Macmillan and Co., Ltd.) Price 2s.

THE standard of this book is suitable for the junior classes of intermediate and secondary schools in which chemistry is used as a form subject, and the matter in it covers almost the same ground as that in the chemical part of Perkin and Lean's "Introduction to Chemistry and Physics." The treatment is rather different, as the historical side is not mentioned. The students are expected to have been taken through some course in physics or experimental science before they begin this course. It is important that they should have done so, as they are supposed to understand the balance, to weigh to milligrammes and to know the meaning of many physical terms.

The book opens with chapters on the description of bodies. Much attention should be given to this, as in a recent examination, when a fragment of Iceland spar was given for description, only a very small percentage of candidates recognised that definite shape was characteristic of the substance. Then follow chapters on simple operations, solution, evaporation, distillation. Afterwards come chapters on rusting, combustion, oxygen, hydrogen, chalk, coal and coal-gas, salt and salt-gas, and finally on acids and bases.

Some of the methods appear to us to be too elaborate for young children. There is, for instance, the complicated aspirator, which experience has taught the present writer is hardly ever clearly grasped. The correction for pressure is always a difficult point. Again, the students should never be allowed to make statements such as "1 litre of hydrogen weighs 0·09 gm." or "density of chalk-gas 0·00198 gm. per c.c." without stating definitely the temperature and pressure at which the weight or density has been ascertained.

We should have liked to have seen more attention given to the indestructibility and conservation of matter. This principle of chemistry cannot be grasped too early. Many of the elementary experiments are conducted with its tacit assumption, and we think it should be pointed out to the student. S. S.

Next to the Ground; Chronicles of a Country Side. By Martha McCullock Williams. Pp. xii + 386. (London: Heinemann, 1902.)

IN this dainty little volume, the author affords English readers a most interesting series of glimpses of the charms and passing events of everyday country life in the United States, after the fashion which so many writers have made familiar in England. A close observer of nature, and evidently imbued with the spirit that everything has an interest of its own, if looked at in the proper light, the author has hit upon a congenial subject, and treated it in a manner which affords an excellent example of the best style of "nature-teaching." The scene is laid in a southern county lying to the westward of the Alleghanies and eastward of the Mississippi, nearly midway between the mountains and the river; and whether describing ploughing with mules or oxen, discoursing of the quail, the partridge or the opossum, discussing shooting and fox-hunting or writing on horses, cows and pigs, the author is equally at home and equally interesting. Some of the information given, such

as the fact that the Derby is a race for three-year-olds (p. 255) and that female foxes are properly called vixens (p. 305) is perhaps somewhat superfluous, for English readers at any rate; and we rather fail to see why pigs are called cousins of opossums (p. 149).

To the naturalist, the most interesting chapters are those on wasps and ants, the "possum," quail and partridge, and insects generally, the account of the habits of the opossum being especially good. In the chapte on fox-hunting, the author confirms the statement of other writers that the so-called red fox (the American representative of the European species) cannot be run down without a relay of dogs, or, as we should say, hounds. Whether, however, this is due to the greater speed of American foxes or the inferior pace of American hounds remains to be told. In teaching people how much is to be learnt from the intelligent observation of ordinary surroundings, the book before us is clearly a step in the right direction. R. L.

L'Age de la Pierre. By G. Rivière. "Bibliothèque d'Histoire et de Géographie universelles." Pp. 183. (Paris: Schleicher Frères.) Price 2 francs.

IN this book we have a popular account of the Stone age following the traditional lines of French archæology. The author does not pay much attention to any discoveries out of France, but the French evidence being so complete this does not matter very much, especially as the book is not intended for students. The transition between the Palæolithic and Neolithic ages is recognised, and the author brings out clearly the culture of the immigrant Neolithic brachycephals. The statement on p. 136 that "certain peoples of Oceania still use very similar sticks [to the curved throw-stick of Egypt] which they call boomerang" is inexcusably vague. A description of megalithic monuments closes the account of the Neolithic age. The last chapter deals briefly with trepanation as a surgical method in Neolithic times. The author still employs the absurd term "bâtons de commandement" for the carved perforated antlers found in the caves; surely he must have known of the conclusive paper read by O. Schoetensack before the Congrès International d'Anthropologie et d'Archéologie at Paris in 1900, in which the author demonstrated their similarity to the bone dress fasteners of the Eskimo. In addition to twenty-six figures in the text, there are four half-tone plates, three from the paintings of Jamin and one from Cormon, which illustrate in a dramatic manner various incidents in the life of the men of the Stone age.

Flora of the Liverpool District. By C. T. Green. Pp. xii + 207. (Liverpool: D. Marples and Co., 1902.) Price 5*s.* net.

THE present work replaces a previous "Flora of Liverpool," which was originally published in 1872 and to which, later on, appendices were added. The revision of previous records and the compilation of recent data have been undertaken by members of the Liverpool Naturalists' Field Club, under the direction of Dr. Green. An original feature of the book consists of illustrations specially drawn by Miss E. M. Wood. These are for the most part characteristic and lifelike, and the figures of certain less common species such as *Ranunculus Lenormandi*, *Viola carpatica*, *Juncus supinus* and others are very useful, but in many instances the important features of the plant are omitted, or at any rate not emphasised, *e.g.* the root of *Lathyrus macrorhizus*. In the case of localities where plants are now extinct, as, for instance, Oxton Heath, it would have been well to notify this more definitely. It will be observed that comparatively recent strangers are being admitted, notably *Lycium barbarum*, while *Solanum rostratum* represents a quite modern American invasion. The geological chapter does not serve to dispel the impression that the book is too much of a dry catalogue, and even the submerged forest at Leasowe receives but a brief mention.

Examples in Algebra. By C. O. Tuckey, B.A. Pp. viii + 178. (London: Bell and Sons.)

IN making this collection, Mr. Tuckey has kept in mind the recommendations of the committee on the teaching of mathematics appointed by the Mathematical Association, and the result is seen in various welcome innovations. Thus, for instance, exercises on the use of graphs are given, some at quite an early stage; there are problems to show the application of algebra to geometry, mensuration and elementary physics, and so on. Checks on accuracy are frequently suggested, and there are numerous questions to be answered orally. Particularly good sets of questions are those on "Formulæ" (p. 23) and "On the Use of Theory of Form as Check" (p. 93). Merely artificial conundrums are happily rare; the worst we have noticed is "Simplify $\sum_{abc} \frac{1}{1 + x^{a-b} + x^{a-c}}$." Undoubtedly this is a very good collection, which may be recommended without reservation.

Children's Gardens. By the Hon. Mrs. Evelyn Cecil (Alicia Amherst). Pp. xv + 212; with illustrations (London: Macmillan and Co., Ltd., 1902.) Price 6*s.*

THE object of this daintily produced volume, with its profusion of beautiful illustrations, is to teach children enough about gardening to enable them to find pleasure and profit in the study and cultivation of plants. The book is written in a simple, practical way, and should be of real assistance to those who are able to indulge their taste for horticulture without too much attention to expense. Judging from the style of the book, we should say that the author will succeed in winning and retaining the interest of young children, who will, by the way, find occupation for the winter months as well as for the brighter seasons of the year. Directions are given as to how to utilise the leisure hours of winter in reading about the plants, in manufacturing garden seats and so on, for use in the garden during the days of summer. Altogether a pretty gift book.

School of the Woods: some Life Studies of Animal Instincts and Animal Training. By William J. Long. Illustrated by Charles Copeland. Pp. xiii + 364. (Boston, U.S.A., and London: Ginn and Co., 1902.) Price 7*s.* 6*d.*

MR. LONG believes that an animal's success or failure in the ceaseless struggle for life depends, not upon instinct, but upon the kind of training which the animal receives from its mother. He has written most of the sketches contained in this attractive volume in the woods, with the subjects themselves living just outside his tent door. The result is that we are provided with an interesting book which will go a long way to make all who read it lovers of nature and sympathetic, intelligent observers of animal life. Mr. Copeland's excellent pictures will help very much to make the book a favourite with children.

Macmillan's Short Geography of the World. A New Handbook for Teachers and Students. By George F. Bosworth. Pp. vi + 197; with maps. (London: Macmillan and Co., Ltd., 1902.) Price 1*s.* 6*d.*

THIS little book deals in a brief manner with the chief facts in the physical and political geography of the countries of the world. Numerous clear maps will enable the beginner to find many of the places mentioned in the text without the aid of a separate atlas. There is scarcely enough information about the many subjects included in the book to make the geography lesson interesting to children, but as a summary the book may be useful

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Note on the Discovery of the Human Trypanosome.

WE have recently seen in the medical Press several very inaccurate accounts regarding the authorship of the important new discovery of trypanosomes in human blood, and of the disease caused by them. For instance, the *Journal of Tropical Medicine* for November 1 (in giving an anonymous description, supported by an editorial, of a case just observed by Drs. Daniels and Manson) attributes the original discovery to Dr. R. M. Forde. It does not mention even the name of Dr. J. Everett Dutton. Dr. Dutton is an old student and assistant in this Laboratory, and is now away on the West African Coast; and we are of opinion that he has a claim to be considered in the matter of this discovery. Another periodical, *The Hospital* for November 8, while also omitting Dr. Dutton's name, states that the discovery was made "within the last few days" by the London School of Tropical Medicine. We believe that such statements are calculated to distort the history of the discovery, and should therefore like to have an opportunity for correcting them promptly in your pages.

The facts regarding the history of the discovery—which was made nearly a year ago—have already been publicly and adequately stated both by Dr. Forde[1] and by Dr. Dutton.[2] Dr. Forde, Colonial Surgeon, British Gambia, tells us that the case in which the parasites were first observed came under his notice in May, 1901; that he found in the blood "small worm-like, extremely active bodies, which I prematurely pronounced a species of filaria," although this conclusion "became doubtful after repeated observations of the parasite"; and that he showed the case in December, 1901, to Dr. J. Everett Dutton, then upon a mission of the Liverpool School of Tropical Medicine to the Gambia, and that Dr. Dutton "at once recognised" the parasite "as a species of Trypanosoma." Dr. Dutton's two papers corroborate these statements of Dr. Forde. After the recognition of the new organism, Dr. Forde gave the first records of the case to Dr Dutton. Dr. Dutton it was, as Dr. Forde says, who recognised that the fever was of a peculiar undulant type; Dr. Dutton it was who positively excluded malaria as the cause of the symptoms; it was he who saw that those symptoms roughly resemble those of tsetse-fly disease and surra; it is he who has published accurate and able descriptions, drawings and charts of the parasites and of the case; and it is he who is now, with Dr. Todd, investigating the subject in West Africa for the Liverpool School of Tropical Medicine.

Dr. Forde is undoubtedly deserving of great credit for his part in the matter, and we think his name should be associated with the discovery. But, until Dr. Dutton was called in, he published no account of the case and did not recognise the nature of the parasite, or the peculiarity of the symptoms. In order to make a discovery, it is not sufficient merely to see an object; it is necessary also to recognise the nature of the object seen and to publish accurate and adequate descriptions of it. For example, Virchow and others long ago saw the parasites of malaria without recognising their parasitic nature; but it is to Laveran, who did recognise their nature, that science gives the credit for the discovery of them. It is certain that Dr. Dutton was the first clearly to observe and to signal the existence of trypanosomes in human blood, and the first to give accurate descriptions of the new organism; and it is to him that science will give the principal credit for the new observation.

It seems to us particularly unfortunate that the *Journal of Tropical Medicine* should have so ostentatiously omitted the name of Dr. Dutton at the moment when it was engaged in giving great prominence to a case of Drs. Manson and Daniels, which, after all, would probably have escaped notice but for the previous work of Dutton. We may mention also—and this is another point which the *Journal of Tropical Medicine* appears to have forgotten—that before his departure for Africa, Dr. Dutton gave at this Laboratory a detailed demonstration, both of the parasite and the clinical features of the case, to Drs. Manson and Daniels, and to one of the editors of the periodical referred to. The omission, then, appears to be due rather to want of memory than to want of knowledge. The journal also states that while the first case (namely, that of Dutton and Forde) was regarded only as a "curiosity," the "discovery of a second case" (namely, that of Daniels and Manson) "opens up a new field for investigation and elucidation," and so on. This view of the relative importance of an original discovery and of a mere confirmation of that discovery is somewhat novel. But the case of Drs. Manson and Daniels is not the second case at all. The second case—also discovered by Dr. Dutton—was that of a child in British Gambia.

It is unnecessary, after what has been said, to deal with the statement made in *The Hospital*. It affords, however, an instance of the curiously rapid manner in which such errors are often propagated in the Press.

We should note that Barron and Nepveu have also claimed to have found flagellates in human blood; but, as will be seen from their writings, their descriptions are so inadequate as to fail to convince us of the accuracy or even the nature of their observations.

RUBERT BOYCE,
RONALD ROSS,
CH. S. SHERRINGTON.

Thompson Yates Laboratories,
University College, Liverpool.

[1] *Journal of Tropical Medicine*, September 1

[2] "Thompson Yates Laboratory Reports," vol. iv. part ii., May; and *British Medical Journal*, September 20.

The Secular Bending of a Marble Slab under its own Weight.

JUST east of the old brick church in the Rock Creek Cemetery near the Soldiers' Home in Washington is a phenomenon which, so far as I know, is unique. A marble slab, originally plane and resting on four posts at the corners, in the course of about half a century has gradually bent under its own weight and a section of it assumed the figure of a catenary. Careful measurement shows the slab to be 2 inches thick, 35 inches wide and 70 inches long; the posts supporting the slab are 7·5 by 6·75 inches in horizontal section, and so placed that the inner edges (which now furnish the support) are 52 inches apart. The stone has bent so much that the ends of the slab are tipped up one inch above the outer edges of the posts on which they formerly rested. At a distance of 12 inches from the ends, the bending is 1·25 inches; at a distance of 24 inches, the bending is 2·50 inches; and at the centre (distant 35 inches from either end), the bending is 3·05 inches. The stone is a little rough from the effects of atmospheric decomposition, and, of course, the hundredth of an inch is hardly to be depended upon in these measures.

Inquiry as to the epoch of erecting the stone did not lead to definite information, but the inscription gave a date of 1853, thus indicating that it has probably been in position approximately half a century. The superintendent of the grounds has been there some twenty years, and he assured us that the bending of the stone had become much more decided in recent years.

The slab is composed of white marble, of about the texture of the material used by sculptors, and appears sufficiently crystalline and homogeneous to take a polish. On the under surface, the stretching of the material has given rise to a number of small cracks, such as develop in plaster where it bends. The chief interest in the phenomenon arises from the evidence it furnishes that *marble is in reality a fluid of enormous viscosity*. This has, of course, some bearing on the question of the rigidity of the rocks composing the crust of the earth and the gradual adjustment of the earth's figure under gravity.

T. J. J. SEE.

Washington, D.C., November 3.

November Swallows.

SINCE the end of October I had not seen a single swallow. This afternoon, however, between four and five o'clock, I saw a party of six, or more, leisurely hawking over the trees and house-tops. It was occasional appearances such as this, after the general exodus, which led Gilbert White to believe that swallows did not all migrate. On seeing some on November 4, near Newhaven, he writes:—

"I am more and more induced to believe that many of the

swallow kind do not depart from this island, but lay themselves up in holes and caverns; and do, insect-like and bat-like, come forth at mild times and then retire to their *latebrae*."

So far as I can make out, November 7 is the latest date on which White records having seen swallows. In 1900 I observed them here throughout the month of November—usually not more than from one to three at a time—up to November 30. In 1901 I never saw one after the end of October.

Recent study of migration seems to show that those individuals of a species which breed farthest north are the last to migrate south. But it is hard to believe that these November swallows are those which have bred in the most northern region visited by the species, say, Iceland and the Faroes. How could they have subsisted in those more boreal climes while ours, "foggy, raw and dull," forced them to flee across the seas? I venture to suggest that they are individuals which had already accomplished a part of their southward retreat. They had reached, perhaps, the south of France or Spain. It would be a small matter for such powerful fliers to pop back for a brief interval, tempted by a spell of mild weather. And there is reason to believe that in retiring to their winter quarters many species perform the journey in a much more leisurely fashion than when they make their great rush to their breeding grounds.

G. W. BULMAN.

13 Vicarage Drive, Eastbourne, November 12.

THE MYCENÆAN DISCOVERIES IN CRETE.

FOR several years past the attention of archæologists has been directed more and more to Crete. The reasons for this access of interest in the antiquities of the great Mediterranean island have already been explained in the two articles on the "Older Civilisation of Greece," which appeared in NATURE, vol. lxiv. p. 11, and vol. lxvi. p. 390. In Crete, revelations of the older culture of the Greek lands are now being made at a very rapid rate, and it is to Mr. Arthur Evans that the palm for these revelations must be awarded. Through many years of greater or less success he has explored the byways of Crete, convinced that the great island would eventually yield results of the greatest importance for the elucidation of the early history of Mediterranean civilisation, and now he has had his reward in the remarkable discoveries which have attended the systematic excavations which he has at last been able to carry out on the site of the ancient Knossos, the city of Minos himself. It is the excavation of Knossos which has directed public attention to the possibilities of Cretan exploration, and there is no doubt that in importance this excavation ranks far higher than any other in Crete. This being so, it is with Knossos that we may fitly commence our survey of these Cretan explorations. Enough has been said in the two articles previously mentioned to give the reader a general idea of the discoveries at Knossos, and of the peculiar characteristics of the earlier Mycenæan age in Crete—which we ought, perhaps, rather to designate, with Mr. Evans, the "Minoan" age—which have been revealed by these discoveries.

Knossos lies about four miles south of the town of Candia, or Herákleion, as the Greeks call it. The walk thither is pleasant; the road (a rarity in Crete) resembles any English country lane. In front rises the curious isolated cone of Iuktas, the fabled burial-place of Zeus, which seems steadily to increase in size as we proceed southwards, and at Knossos dominates the surrounding country. Breasting a hill, Iuktas comes into fuller view; on either hand are rolling downs, backed by mountains; further on, a couple of roadside wine-shops, a house, and a path off to the left across the fields to a white patch with a wooden summer-house in the middle of it, from the top of which floats the Union Jack; this is Knossos, where Minos judged, where Theseus slew the Minotaur.

Coming from the west, one enters first the great western court, which, if one is not a timid Dryasdust, but an archæologist who takes pleasure in repeopling the ground on which he stands with those heroic figures which are associated with it in legend, one may call the Dancing-floor of Ariadne if one will. Crossing to the south-west corner, one reaches the remains of a great gate at this end of the beautiful wall of polished gypsum blocks which separates the court from the rest of the palace, and so round through the corridors which once were adorned with frescoes of tribute-bearers coming in procession, into the long north-and-south gallery out of which open to the left the curious long cupboard-rooms or "magazines" in which were stored the great earthenware *pithoi*, with ornament in relief, containing tablets or other objects of value, which are so characteristic of Minoan palaces. Most of these remain *in situ*, some broken or overturned by falls of masonry, many roughly restored with plaster to keep them together. In the floors open the curious lead-lined safes or receptacles for valuables, called "Kasellais" by the diggers, made with the greatest care in double tiers, and still almost excavator-proof. Unluckily, most of the golden treasures which they once contained seem to have been removed before the final catastrophe which overwhelmed the palace of Minos. Over one of these magazines stands the "summer-house" already mentioned, which is really a kind of gazebo, built by Mr. Evans for the purpose of obtaining a panoramic view of the excavations. Hence we pass round to the right, to the throne-room, which opens on to the central court. This is now roofed over, in order to protect its contents from the weather, and the curious brightly-coloured modern Mycenæan pillars, tapering from capital to base, which occupy the site of the ancient columns, with the red-painted walls, give us an interesting idea of what the place once looked like. It should be remembered that there is no "restoration" here; it is purely a work of conservation; the form and colour of the modern pillars are supplied from a Knossian fresco, the colour of the modern walls is but a continuation of the colouring of the ancient. The effect is good. Leaving the throne-room of Minos, with its curious throne with back in the form of an oak-leaf and legs carved with Gothic crockets, its stone seats for the councillors, its bath and its great stone bowl, we cross the central court eastwards to the edge of the hill, and then descend part of the wonderful quadruple staircase, which was excavated by Mr. Evans with so much difficulty and is now held in place by wooden arches, to the "Hall of the Colonnades," in which one might fancy oneself in the court of an Italian palace. Above us is an open loggia, which can be attained from half-way up the stairs. The existing palace is just here nearly three stories high, and was originally four or more! As Mr. Evans points out (*Journal of Hellenic Studies*, xxi. p. 335), "even at Pompeii staircases one over the other have not been brought to light." Passing out, we reach the "Hall of the Double-Axes," so called from its pillars and wall-blocks, which are engraved with the mystic sign of the god of Knossos and of Diktê, who was afterwards (?) identified with the Aryan Zeus. Everybody knows the brilliant philological explanation by Mayer and Kretschmer which has made clear the meaning of *Λαβύρινθος* as "Place of the Double-Axe," and so has converted the guess that the Knossian palace is the Labyrinth itself into a practical certainty.[1] One

[1] In the *Journal of Hellenic Studies*, xxi. part ii. p. 268, Mr. W. H. D. Rouse complains of my having followed Mr. Evans in accepting this explanation of the word "*Λαβύρινθος*" and having adopted his identification of the Knossian palace with the Labyrinth in my book "The Oldest Civilization of Greece." Mr. Rouse does not accept the explanation, and so will not adopt the identification. I apprehend, however, that his refusal to accept the explanation of the name is due to the fact that he is hardly cognisant of all the arguments for it. For instance, he says that the termination *-νθος* is not explained! (*loc. cit.* p. 274). He will find it fully explained in

may believe in the existence of the Labyrinth without believing in the existence of an actual Minotaur!

Leaving the Hall of the Double-Axes, we bear round to the left above the little valley of the Kairatos to the ancient northern entrance, where is to be seen a very interesting surface-drain which carried off water from the central court. And now we again stand outside the palace with our faces turned in the direction of Candia.

Looking back, we are at once struck by a feature of Knossos which entirely differentiates it from Tiryns or Mycenæ. It is not fortified. "Bastions" there may be at the northern entrance, but they do not seem to have been of any particular military value. The Labyrinth was not a fortress, it was a peace-time palace, the residence of kings who ruled a settled people and needed not to fear armed attack. But one day war came to Knossos, and the dominion of the proud Minoan thalassocrats disappeared in the smoke of the burning Labyrinth.

This open and unfortified character of the palace testifies to the high state of civilisation of the Minoan Knossians, thus agreeing with all tradition of the great Cretan law-giver who personifies the ancient princes of Knossos. But high civilisation often brings degeneracy in its train, and, as has already been pointed out in these columns (vol. lxvi. p. 393), there are many traits in the culture of Knossos which give the modern observer a decidedly sinister impression.

Of the Mycenæan town of Knossos, excavated by Mr. Hogarth in 1900, which lay to the south-west of the palace, there is not much to be seen. A discovery of Mr. Evans's, made during the present season (1902) and communicated by him to the *Times*, may, however, give us some idea of what the town may have looked like. To quote Mr. Evans:—"This is the remains of a mosaic, consisting of small porcelain plaques, which in its original form seems to have represented scenes disposed in various zones recalling the subjects of Achilles' shield—the walls and houses of a city, a river, a vine and other trees, warriors with bows, spears, and throwing sticks, besiegers and defenders, and various animals. But the most surprising part of all are the houses of which the city is composed. Fragmentary as are their remains, it has been possible to reconstitute about a couple of score of these. The varying character of the structure—stone, timber, and plastered rubble—is accurately reproduced; and the walls, towers, gateways—a whole street of a Minoan city rises before us much as it originally stood. But what is even more surprising than the fact that the elevations of these prehistoric structures should be thus recovered for us intact from the gulfs of time is the altogether modern character of some of their features. Here are three-storeyed houses (some of the semi-detached class showing two contiguous doorways) with windows of four panes, or double windows of three panes each, which seem to show that the inmates of the houses had actually some substitute for glass." Perhaps they had window-glass; why not? It was known to the Romans, and has been found at Pompeii. However this may be, it would indeed seem, as Mr. Evans says, "as if the brilliant and unexpected character of the finds" at Knossos is "likely to maintain itself to the last."

the chapters of Kretschmer's *Einleitung* on the languages of Asia Minor and the pre-Hellenic population of Greece (x., xi., p. 289 *ff.*; *esp.* p. 404). I should also like to refer him to my article in NATURE November 14, 1901, Suppl. p. vii, where he will find the matter explained to the best of my ability. With regard to another point which has been urged against the correctness of the identification of the Knossian palace with the Labyrinth as being, *par excellence*, the "Place of the Double-Axe," I confess that I do not see that the fact of the Double-Axe sign being cut upon the rough stone blocks of the walls, which were intended to be covered with stucco or with gypsum slabs, is of much weight, as I am inclined to regard these signs as hieroglyphs, intended merely for the guidance of the masons, signifying that such and such a block was intended for a building or room somehow connected with the worship of the god of the Double-Axe. Indeed, the hieroglyphic of their tutelary deity may have been used by the Minoans as a sort of heraldic device to mark "Government stores," exactly like the British "broad arrow." I do not know whether this explanation will commend itself to Mr. Rouse or not, but it appears natural enough to a student of Egyptology.

We retrace our steps to Candia and thence start for Phaistos, on horse- or mule-back. We pass Knossos once more, we pass Iuktas, and so on over the watershed between the Ægean and Libyan seas, with snowy Psiloriti (Ida) on the right hand and Lasíthi (Diktê) on the left, into the Messará, the valley of the Ieropotamos, to the acropolis-hill of Gortyna, which stands at the entrance of a remarkable gorge through which flows the Lethaios of the ancients. The site of this once famous city, which supplanted both Knossos and Phaistos as the chief town of Crete, was investigated by the Italians two or three years ago, and again examined by Mr. Taramelli in 1901; he found no traces of occupation in Mycenæan days. Hence we pass down the broad Messará to the triple acropolis of Phaistos at Agia Photiá, first identified by Admiral Spratt.

Phaistos stands upon a triple-peaked hill, which forms the end of the spur which divides the Messará from the maritime plain of Dhibáki, where the Ieropotamos reaches the sea. At its base runs the Ieropotamos. Its situation is therefore much stronger than that of Knossos, and seems to be better adapted for a fortress than the low knoll on which the Minoan metropolis stood. On the third, the lowest, peak, Prof. Halbherr and the Italian expedition have excavated a Mycenæan palace, the architecture of which is entirely Knossian—Minoan—in type; we find here the same corridors, the same magazines, the same pillared halls and open courts as at Knossos. There is no doubt whatever that the palaces of Knossos and Phaistos were built by the same people and approximately at the same period. Legend ascribes the foundation of Phaistos to Minos, and there is no reason to doubt that this legend enshrines forgotten history. If, then, Phaistos was founded by the Knossians, its palace would be expected to show signs of a somewhat later date than Knossos. These signs are quite apparent. Phaistos marks a development of, an improvement on, Knossos. In some ways it must have been much finer; certainly its ruins are much more impressive. The masonry at Knossos is neither so good nor so well preserved as that at Phaistos; the curious triangular θεάτρον at Phaistos, with its altar and tiers of stone seats, has no parallel in the mother-palace, nor has the latter now anything to compare with the great and broad stairway which leads up to the pillared hall at Phaistos, although it is possible that some similar stairway may once have existed at Knossos, but has now disappeared. Phaistos, then, makes a finer show than Knossos, but is really far less interesting. In the first place, it has no legendary past to speak of; we know nothing of its ancient dynasts, while Knossos was the city of Minos, the metropolis of the ancient dominion over land and sea which is connected with the name of the great legendary lawgiver, and its palace is in all probability the identical Labyrinth which the legendary Dædalus built for the great king. In the second place, Phaistos is nothing but bare walls, fine though their masonry may be, and has yielded practically none of those minor discoveries which tell us so much more than bare walls can; while Knossos, on the other hand, has, as we know, yielded minor discoveries of the utmost importance, which have revealed to us most of our present knowledge of Minoan civilisation and have told us its date.

One difference between Knossos and Phaistos, however, is noticeable, and that a somewhat significant one. Phaistos was more strongly fortified than Knossos, and in many places the palace walls, built of ponderous stones like Mycenæ and Tiryns, are visible. This we should expect in a building which was evidently placed where it is for more or less military reasons, and it confirms the idea that Phaistos was built by the Minoan rulers of Knossos with the direct purpose of controlling

the mouth of the Ieropotamos and the more southerly haven of Mátala, and so securing the communications of Knossos with the southern sea. Originally founded by the Knossian princes Phaistos probably was not; such a site must always have been occupied from the earliest days of human settlement in the Messará, and, as a matter of fact, primitive pottery of days long anterior to the Mycenæan period has been found at Phaistos, and in the near neighbourhood is Agios Onouphrios, where one of the most important discoveries in Crete, that of burials of the primitive pre-Mycenæan or "Amorgian" period, containing Egyptian scarabs of the twelfth dynasty (*c.* 2200 B.C.), was made in 1887. But its foundation as an important city Phaistos no doubt owed to the conquering rulers of Knossos, and to them the construction of its fortified palace is most probably due.

This season is announced the discovery at Agia Triadha, between Phaistos and the sea, of what is described as a "country residence" of the Phæstian princes, which will no doubt prove of very great interest. Indeed, it appears that a large number of Mycenæan seals, an inscribed tablet of the Knossian type, and other objects of interest, including a portion of a stone vase sculptured with a most realistic representation in relief of a body of men leaping and dancing in a religious procession (apparently a harvest-home, judging from the implements carried by the dancers), have already been found here. The neighbourhood of Phaistos is rich in remains of the older civilisation of Greece. Northwards, at the end of a valley of Ida, lies the cave of Kamárais, where was found the store of that peculiar pottery which has proved to be characteristic of the period of Cretan art which immediately precedes the true "Mycenæan," the period to which the earliest foundation of the palaces both of Knossos and of Phaistos must be assigned, the period, probably, of the earliest Minoan kings. A large store of this ware was discovered by Mr. Hogarth in the town of Knossos, and it has also been found at Phaistos, Zakro and other Minoan sites. Further, and this is most interesting, it was also found by Prof. Petrie at Kahun, in Egypt, and may there be roughly dated to the period between the twelfth and eighteenth dynasties, not earlier than the twelfth, but no doubt earlier than the eighteenth. It was, then, imported into Egypt from Crete between 2000 and 1700 B.C. Here is another piece of evidence as to date which fits in absolutely with the evidence of the alabastron-lid of Khyan and the statuette of Àbnub, found at Knossos.[1] Everything points to *c.* 2000–1500 B.C. as the date to be assigned to the early Minoan period.

The other well-known cave on Mount Ida, the "Idæan Cave" *par excellence*, explored by Messrs. Halbherr and Orsi, contained objects, mostly of post-Mycenæan and early classical date, exhibiting strong traces of Phœnician influence. It lies further north, above the Nida plain.

To the south-east, in the direction of Gortyna, stood once a Mycenæan city on the curious isolated hill of Kourtais, the necropolis of which has yielded interesting Late-Mycenæan and Geometrical finds. Another explored site which may be mentioned is Priniá, to the north; away to the east, in the province of Pediada, where the Omphalian Plain meets the lofty mountains of Lasithi, the ancient Diktê, and the as yet unexplored site of Lyttos awaits the excavator's spade, the necropolis of Erganos has yielded the interesting tombs of a Mycenæan hill-settlement, and the district of Embaros innumerable traces of extensive occupation in Mycenæan times, both early and late. This country must in Minoan days have formed part of the immediate territory of Knossos; the town of Lykastos, which lay within it, was said to have been founded by Minos, and Lyttos is associated with the legends of the Cretan Zeus, who was supposed to have passed his childhood in a cave on the slopes of Diktê. This cave has been identified, and Mr. Hogarth has explored it. It is a "large double cavern situated to south-west of, and about 500 feet higher than Psychro, a village of the upland Lasithi plain," a curious tract which lies in the middle of and surrounded by the Dictæan mountains. Mr. Hogarth's discoveries in the Dictæan Cave have already been noticed in NATURE (vol. lxiv. p. 15); it need only be said here that he has shown that it was probably one of the holiest places of Crete, and the hundreds of Mycenæan votive double-axes which he found are final proof of the identity of the prehistoric God of the Double-Axe with the Cretan Zeus, which again shows the identity of the Cretan with the Karian Zeus, whose emblem was the λάβρυς or Double-Axe and the seat of whose worship was Labraunda, which confirms the equation Λαβραυ-νδα = Λαβυρι-νθος, explains Λαβύρινθος as the "Place of the Double-Axe," and so identifies the Knossian palace as the Labyrinth of Minos. Most interesting is the discovery in the Dictæan Cave of a bronze figure of the Egyptian God Amen-Rā, Amonrasonter, "the King of the Gods," probably dating to about the eleventh or tenth centuries B.C., which was perhaps dedicated by some Egyptian traveller who identified the God of the Double-Axe with his own supreme deity, thus anticipating the later conjunction Zeus-Ammon by many hundred years! From this cave came the well-known inscribed libation-table, now in the Ashmolean Museum. It was no doubt from Diktê that the Cretan mountain-goddess Diktynna, also called Britomartis, took her name, and not from the Greek δίκτυον, "a net."[1]

South-west of Diktê is a district in which many Mycenæan sites still await the spade, as at Rotási (Rhytion) and Viano (Biennos); on the south coast is Arvi, where, a few years ago, an important find of early Mycenæan stone vases was made, and where an ancient cult of Zeus probably points to a direct connection with Knossos.

Rounding the northern slopes of Diktê, we enter the province of Mirabello, where, at Milato on the north coast, an important Mycenæan tomb has been found, and where, further south, the imposing ruins of Goulàs, the ancient Lato, investigated by Messrs. Evans and Myres and afterwards partly excavated by a French explorer, M. de Margne, without much success, no doubt mark the site of a Minoan city and palace. The place-name Minoa preserved in classical days the tradition of Knossian domination hereabouts also. We have now reached another depression in the mountain-system of Crete, the hilly plain which lies between the Gulf of Mirabello and the district of Hierapytna on the south coast. Before us to the east rises another mountain-mass, which stretches from sea to sea and seems to block all further progress eastward. This is the Aphendi Vouno of Kavousi, which bars off from the rest of Crete the extreme eastern portion of the island, the modern province of Sitía, of old the territory of the Eteokretans, who were said to be first cousins of the non-Aryan Lycians, and certainly still spoke an absolutely non-Greek idiom even in classical times. In the Eteokretan country itself we find little proof of Minoan occupation except here and there on the coast, so it is probable that direct Knossian control in Minoan times ended with the Hierapytnian territory. The most easterly Minoan town in this district appears to be that discovered in 1901 by Miss Harriet Boyd at Gournia, on the Gulf of Mirabello, at the foot of the Aphendi, and nearly opposite the island of Psyra. In the same neighbourhood, at Kavousi, Miss Boyd had made fruitful excavations in the preceding year, but her discoveries at Gournia far

[1] See NATURE, vol. lxvi. p. 392. The identification of the Kahun ware with that of Kamárais is due to Mr. J. L. Myres.

[1] See "The Oldest Civilization of Greece," p. 296, where I have explained the form of the name.

exceed these in interest, and are of such great importance that the following short description of them, taken from the *American Journal of Archaeology* for January–March of this year, p. 71, is here quoted:—"A Mycenæan acropolis was found, approached by two long streets, about 5 feet wide, with terra-cotta gutters and good stone pavements. These lead to the palace of the Prince. Right and left are side streets and houses. The steeper parts of the roads are built in steps. The houses have rubble foundations, but the upper walls are of brick. In some parts of the palace the upper walls are of ashlar. Several houses have walls standing to the height of 6 or 8 feet. Plaster is used extensively for the facing of walls and door jambs. There are many proofs of the existence of a second story. Twelve houses have been excavated, most of which have eight rooms or more. Of the palace, fourteen rooms have been excavated, chiefly magazines, like those at Cnossus. A terrace court, a column base, and an aula, evidently belonging to a portal, have been uncovered. In the centre of the town is a shrine. It is a small, rectangular building, near the top of the hill. The most noteworthy of its contents are a low terra-cotta table, with three legs, which possibly served as an altar; cultus vases with symbols of Mycenæan worship; the disk, 'consecrated horns of the altar' [see NATURE, November 14, 1901, Suppl. p. vii.], and the double-headed Axe; and a terra-cotta idol of the 'Glaucopis Athene' type, with snakes as attributes . . ." The smaller objects found are of the usual Mycenæan type, including stone and bronze utensils. Very significant is the fact that the Double-Axe is found painted on vases, and carved also on one of the stone blocks of the palace, as at Knossos and at Phaistos. This marks the place as Minoan at once. Very possibly it was the frontier-town of the Knossian dominion on the Eteokretan border. It is "the most perfect example yet discovered of a small Mycenæan town." In fact, a Minoan Pompeii on a small scale!

Beyond the Aphendi Kavousi we are in the province of Sitia. On the site of the ancient Eteokretan capital, Praisos, excavations have been carried on by Prof. Halbherr and by Mr. R. C. Bosanquet, the present director of the British School at Athens. Here a few remains of Mycenæan culture were found by Mr. Bosanquet, including a large "beehive" tomb. Another inscription in the non-Hellenic tongue of the Eteokretans[1] was discovered, of course, of a date long posterior to the Mycenæan period!

Mr. Bosanquet has also excavated at Petras, a place on the harbour of Sitia, and, during the present year, at Palaiokastro, on the east coast, south of Cape Sidero, where he has found some very curious Mycenæan interments. Palaiokastro is, I am informed by Mr. Bosanquet, bigger and more important, as a site, than Gournia and Zakro, but more disturbed by cultivation. As a Mycenæan settlement, it is quite as noticeable as Zakro; a remarkable characteristic is the occurrence, dotted all over the plain, of the foundations of Mycenæan farmsteads, on which Mr. Bosanquet lays stress, as a fresh proof of the peaceful security enjoyed by the Mycenæan Cretans. Further south again, at Zakro (which Spratt considered to be the site of Itanos, but probably erroneously, since Erimopoli, north of Palaiokastro, has a better claim to this honour), Mr. Hogarth has discovered the remains of an important Mycenæan port-town, which, he thinks, was a Minoan outpost, a Knossian colony planted here to hold the most important haven on the east coast, which is still used by the sponge-fishers, who make it their rendezvous before starting for the African coast. Mr. Hogarth's discoveries here have been more fully referred to in the last volume of NATURE, p. 394, *q.v.*

We thus see that the main result of the excavations on Mycenæan sites in Crete which have been going on for the past two or three years has been the proof of the existence in the great Mediterranean island of a civilisation which was already ancient and highly developed at least as early as 1700 B.C., and was in connection with Egypt at that date and probably earlier. The origin of this culture is at present veiled from us; but various strange indications of a primeval connection with Egypt seem to point to *Africa* for its origin. More than this cannot be conjectured at present. Its centre seems to have been the central portion of Crete, the territory of Knossos and Phaistos, which is inextricably bound up with the famous legends of Minos and the Knossian thalassocracy. Mr. Evans's discoveries have breathed life into these legends, and though we may not believe in Minos as a historical personage, at any rate we see that he represents a dynasty and a power, and so we can speak of the Minoan dominion in Crete and of the Mycenæan civilisation of Crete, the chief monuments of which are at Knossos and Phaistos, as "Minoan."

The Knossian dominion extended in the east apparently as far as the borders of the independent Eteokretan country. One or two Knossian colonies seem to have been established on its further coast, such as Palaiokastro and Zakro. Similar Minoan colonies seem to have been also established in other islands of the Ægean, as in Melos, at Phylakopí. That we have here a confirmation of the legend of the Minoan thalassocracy there can be little doubt.

How far the Knossian dominion extended westward is as yet unknown. Axos, which lies at the upper end of the Mylopotamo valley at no great distance from the Knossian district, is now being excavated, but has as yet yielded nothing Mycenæan. There can, however, be little doubt that it was a Minoan city. I have elsewhere[1] suggested that the *Uashasha*, who invaded Egypt in concert with other Mediterranean tribes in the reign of Rameses III., probably some three hundred years after the most flourishing period of the Minoan age, were Cretans from Axos, and have given my reasons for the suggested identification. The objection that Axos is an inland town and so would not have taken part in an over-sea expedition is of no weight whatever; like Knossos, Lyttos, or Gortyna, each of which cities possessed a dependant port on the coast, Axos no doubt possessed its coast-haven, either in the neighbourhood of Bali Bay or nearer the mouth of the Mylopotamo. Further, Axos is actually connected in legend with Libya, and Herodotos (iv. 154) mentions traditions which connect it, as well as Itanos, with the Theræan colonisation of Cyrene. Other central and western sites, such as Eleutherna, Hyrtakina, Phalasarna, &c., will no doubt yield Mycenæan remains when excavated. In fact, the whole of Crete seems to be covered with traces of Mycenæan culture; I have not mentioned numbers of unexcavated sites from which inscribed seal-stones, &c., have been obtained.

The Minoan culture was probably older than the Mycenæan civilisation of continental Greece, and there seems little doubt that the original inspiration of the latter was derived from it.

Eventually the highly civilised and apparently peaceful Minoan dominion in Crete, weakened, perhaps, by luxury and unused to war, was overthrown by foreign attack. Who the conquerors were we do not know, but they probably came from the north. We may, perhaps, associate with their attack the convulsions among the

[1] I must here state that in "The Oldest Civilization of Greece," p. 87, I had not the remotest intention of attributing to Mr. Arthur Evans the opinion that the well-known Inscription of Praisos was inscribed in a Semitic idiom. I was fully aware that he held no such view. I merely referred to his "Cretan Pictographs" as the latest authority on the subject generally. Unluckily, the small number pointing to the note below, containing this reference, was misplaced in the text. It was printed after the word "Eteokretans," but should have come after "Praisos," four lines above. I regret that this escaped my notice when reading the proofs of my book, and still more that the nature of the mistake was not understood.

[1] "Oldest Civilization of Greece," p. 177.

Mediterranean tribes which caused the piratical onslaughts on Egypt in the thirteenth and twelfth centuries B.C., in which Cretan wanderers, expelled from their island by the northern newcomers, may well have taken part. It is certain that before this time the highly civilised Minoan Cretans or *Keftiu* had disappeared from the ken of the Egyptians, and are no more seen in Egyptian wall-paintings. One result of this convulsion seems to have been the settlement of a Cretan tribe, the Philistines, on the coast of Palestine.

When Crete emerges from the dark age which followed the break-up of the Minoan power, we find it a congeries of Greek city-states of the usual type, but of a more quarrelsome disposition than elsewhere; in the Minoan land itself, Gortyna conquers and destroys Knossos and Phaistos, in the east Hierapytna wages long wars with Praisos and Itanos, and so forth. Crete takes no part in the colonising activity of the new Greece, and is henceforth of no account in Hellas. Her day of glory had passed away with the Heroic age.

I am indebted to Mr. R. C. Bosanquet for information with regard to the work of the British School at Athens in eastern Crete. Subscriptions for this work will be gladly received by Mr. Walter Leaf, 6 Sussex Place, Regent's Park, N.W.

H. R. HALL.

P.S.—Photographs of the remains at Hyrtakina have been published by Messrs. Savignoni and De Sanctis in their publication "Esplorazione Archeologica delle Provincie Occidentali di Creta" (Rome, 1901). From their publication it would appear that Phalasarna, the most westerly site in the island, was certainly of Mycenæan origin. Near the remains of a city is a colossal stone throne, of the same type as those treated of by the late Dr. Reichel in his "Vorhellenische Götterkulte," on which is a relief of a symbolic pillar (see Evans, "Mycenæan Tree and Pillar-Cults," in the *Journal of Hellenic Studies*, vol. xxi. p. 99 *ff.*; reviewed in NATURE, November 14, 1901, Suppl.). The name Phalasarna is of the now easily recognisable "kleinasiatisch" præ-Hellenic type. Kretschmer has pointed out that the last two syllables may well be the same as the name of the Bœotian Arnê, which he has identified with the Lycian word *arñna*, "city" ("Einleitung in die Geschichte der griechischen Sprache," p. 406). There seem to be Mycenæan traces also at Vlithiàs and at Agia Irene (Kantanos?); see Savignoni and De Sanctis, *loc. cit.*, for photographs of polygonal masonry, &c.

Mr. Bosanquet informs me that he has found Mycenæan pottery-fragments on the small island of Mókhlos (wrongly called Hagios Nikólaos in Kiepert's map of 1897), off the north coast between Kavousi and Sitia.

THE SECOND INSTALMENT OF THE BEN NEVIS OBSERVATIONS.[1]

THE forty-second volume of the *Transactions* of the Royal Society of Edinburgh is devoted to the publication of five years' observations at the Ben Nevis Observatories, in continuation of those included in vol. xxxiv. of the same series of *Transactions* published in 1890, with appendices consisting of discussions of the results. It is edited by Dr. Buchan, the meteorological secretary to the directors of the observatories, and Mr. R. T. Omond, honorary superintendent of the observatories. The cost of printing is borne by the Royal Societies of London and Edinburgh. The observations include hourly readings and summaries of the meteorological elements, together with entries in the log-book at the summit station for the five years 1888-1892, and readings, five times daily, at the public school, Fort William, from January, 1888, to December, 1890; also the hourly readings with various summaries for the Fort William Observatory from the establishment of that institution in the autumn of 1900. There have also been added tables of mean hourly values of the barometer, temperature, &c., at Ben Nevis and Fort William Observatories, computed to the end of 1896, with mean monthly temperatures deduced from independent observations in the Stevenson screen at Fort William for the period August 1, 1890, to December 31, 1896, and differences between the observations in the Stevenson screen and the thermograph screen of the Observatory. It is almost needless to say that the publication of these tables will be welcomed as representing the primary results of an enormous amount of patient and painstaking labour, controlled by a representative board of directors of conspicuous distinction and carried out by a body of enthusiastic observers in circumstances of no little difficulty.

This is not a suitable occasion for dealing independently with the observations, which are presented with the skill and care of which Dr. Buchan is an acknowledged master, and with all the assistance an accomplished printer can afford. We naturally turn to the appendices as representing the scientific results which have been obtained by those who have been associated with the working of the observatories and have devoted time and study to the many problems which the observations suggest.

The appendices consist of a series of papers, some of them *in extenso* and appearing now for the first time, others in abstract or reproduced from the publications of the Royal Society of Edinburgh or the Scottish Meteorological Society by Dr. Buchan, Mr. Aitken, Mr. Buchanan, Mr. Omond, Mr. Mossman and Mr. Rankin.

A brief survey of these discussions is sufficient to show that the problems suggested by the meteorology of Ben Nevis, taken separately or in comparison with that of Fort William, are many and difficult. Dr. Buchan returns to a voluminous but still unexhausted subject in a paper on the diurnal range of the barometer in fine and cloudy weather at stations in various latitudes, from San José, Costa Rica, to Jan Mayen in the North Atlantic. Mr. Aitken's report on atmospheric dust and Mr. Buchanan's discussion of the meteorology of a station in the clouds, as represented by the Ben Nevis records in foggy weather, are already well known contributions to science. The other papers are, as a rule, of less general scope.

Much attention is devoted to the relation of barometric readings at the summit to those at the base station, and here one of the difficulties of Ben Nevis observations becomes very conspicuous. When the velocity of wind reaches or exceeds twenty miles per hour, the barometer reading at the summit no longer represents the pressure of the air within 0·01 inch. All barometric readings with anything more than a moderate wind are subject to a correction of uncertain amount on account of dynamical disturbance. Moreover, the shape of the mountain, with its great cliff on one side of the summit, has a very marked effect upon the wind measures. This circumstance reminds me of a personal experience at Dover during a gale, when the only place in Dover screened from the wind was the top walk of the Admiralty pier, apparently as fully exposed to the gale as any position could be. Such dynamical effects upon barometer and wind make it very difficult to bring the summit observations of these primary meteorological factors into relation with corresponding observations elsewhere.

These are not the only difficulties associated with the reduction of the summit barometer readings to sea level, and the account of the attempts to carry out this reduction

[1] "The Meteorology of the Ben Nevis Observatories." Part ii., containing the Observations for the Years 1888, 1889, 1890, 1891 and 1892, with Appendices. Edited by Alexander Buchan, LL.D., F.R.S., and Robert Trail Omond.

suggests the possibility of regarding the barometric difference between Fort William and the summit as a primary element, without introducing a correction factor based upon a system really applicable only in the case of small heights. Differences from mean value instead of differences from a common hypothetical datum would probably give a more effective representation of the conditions.

The Ben Nevis work, as represented in this volume, is essentially self-contained. In the course of the discussion, observations at other stations are sometimes employed, but the work of other meteorologists concerned with similar problems is hardly referred to. Clayton and Fredlander are the only names I have noticed in the volume not immediately associated with Ben Nevis. This may possibly be accounted for by the majestic isolation of the Ben, but it is in some respects unfortunate. For example, a system is adopted for adjusting the twenty-four-hourly readings for non-periodic changes which is different from that adopted by the Meteorological Council in an annual publication dealing with their first-class observatories, including Fort William. If I judge rightly, one of the two systems must be wrong, and if the error is in Victoria Street it would have been wiser to point out the fact in adopting a different system. Again, a table of equivalents of the numbers of the Beaufort scale and wind velocities is given (pp. 5 and 492), in which numbers on the Beaufort scale are represented by velocities largely exceeding, indeed nearly double, those quoted by Hann ("Meteorologie," p. 377). The practice with regard to the use of velocity equivalents of the Beaufort scale is in a sufficiently chaotic condition already, and it is to be feared that the addition of another scale of equivalents without reference to the reasons for disregarding all other attempts to reduce chaos to order must tend to make confusion a little worse confounded.

The publication of the observations down to 1892, or in part to 1896, may seem to the reader a little belated. The editors are, however, to be warmly congratulated upon the substantial progress made with the work undertaken by the directors. The publication is opportune for two reasons. First, because the question of the future of the observatories is prominently before the public and the volume gives an adequate representation of their work. Secondly, because the International Meteorological Committee meets at Southport next September during the session of the British Association, and the occasion would be a suitable one for the discussion of the interesting questions arising out of observations at high levels. It is justly claimed for Ben Nevis as a high-level station that it is in an unique position. The first recorded entry in the log-book (January 1, 1888) is that the tracks of a hare were seen near the thermometer box. It is not the only hare to be raised on the Ben. If opportunity can be found for the discussion of some of the Ben Nevis hares at Southport, our visitors will relish their highland flavour.

W. N. SHAW.

NOTES.

THE following is a list of those to whom the Royal Society has this year awarded medals. The awards of the Royal medals have received His Majesty the King's approval:—The Copley medal to Lord Lister, in recognition of the value of his physiological and pathological researches in regard to their influence on the modern practice of surgery. The Rumford medal to the Hon. Charles Algernon Parsons, for his success in the application of the steam turbine to industrial purposes, and for its recent extension to navigation. A Royal medal to Prof. Horace Lamb, for his investigations in mathematical physics. A Royal medal to Prof. Edward Albert Schäfer, for his researches into the functions and minute structure of the central nervous system, especially with regard to the motor and sensory functions of the cortex of the brain. The Davy medal to Prof. Svante August Arrhenius, for the application of the theory of dissociation to the explanation of chemical change. The Darwin medal to Mr. Francis Galton, for his numerous contributions to the exact study of heredity and variation contained in "Hereditary Genius," "Natural Inheritance" and other writings. The Buchanan medal to Dr. Sydney A. Monckton Copeman, for his experimental investigations into the bacteriology and comparative pathology of vaccination. The Hughes medal to Prof. Joseph John Thomson, for his numerous contributions to electric science, especially in reference to the phenomena of electric discharge in gases.

MEN of science do not need to be reminded that their interests are cosmopolitan. Contributions to natural knowledge are not weighed in political balances, but by a scale of worth independent of nationality. Every effort should therefore be made to give clear evidence of this unity of spirit and bond of intention. An opportunity of doing this is afforded by the meeting of the American Association for the Advancement of Science, to be held in Washington, D.C., from December 29 of this year to January 3, 1903. At the recent Belfast meeting of the British Association, Prof. C. S. Minot, the president of the sister association across the Atlantic, gave a sincere and hearty invitation to the members of our Association to attend the forthcoming meeting at Washington. There are doubtless many men of science who would accept the invitation with the keenest pleasure if they could leave their work for the few weeks required for a visit to the United States; and if they are unable to do so the loss and regret will be theirs. To those who are able to make the journey, it ought to be regarded as almost a duty—though a pleasurable one—to attend the meeting. The mid-winter meeting is an experiment on the part of the American Association, but it has attracted a large number of affiliated societies, and there is every promise that the meeting will be an important one. Since Prof. Minot gave the cordial invitation at Belfast, a letter has been received from the permanent secretary of the American Association, Dr. L. O. Howard, expressing the hope that at least some of the officers and members of the British Association will be present at the Washington meeting. It will be to the advantage of both science and civilisation if this friendly invitation is accepted.

ANOTHER meeting which men of science who have a few months' holiday at the end of next year should attend is that of the Australasian Association, to be held in Dunedin, New Zealand, in January, 1904. Mr. G. M. Thomson, honorary secretary, has sent a letter to the general secretaries of our Association asking them to make known to members that special opportunities will be given to see the most interesting sights in New Zealand, so that the visit may be made a source of profit as well as of pleasure. Dunedin is the most southerly city of any importance in the British Empire, and it is scarcely necessary to remark that many lands and peoples of interest can be seen by men of science who are able to take a trip around the world to New Zealand. A formal invitation to attend the meeting will be brought before the members of the British Association next year at Southport.

DR. P. L. SCLATER, F.R.S., has resigned the secretaryship of the Zoological Society of London, and only holds office until his successor is appointed. The council has passed the following resolution on this subject and ordered it to be entered on their minutes:—"The president, vice-presidents and council of the Zoological Society of London desire to

record their sincere regret at the retirement of their secretary, Dr. Philip Lutley Sclater, after a service of nearly forty-three years. They wish to tender him their hearty thanks for his most valuable services to the Society during this long period, not only in the management of the Zoological Gardens, but also in the conduct of the publications of the Society and the general direction of its affairs. These affairs have prospered to a remarkable degree during his long term of office. The income of the Society has doubled, the Society's library has been entirely created, the membership has increased from 1500 to 3200. Dr. Sclater's own work as a zoologist is held in universal repute, and it is no exaggeration to say that the very high position occupied at the present day by the Zoological Society in the world of science is largely due to the exertions and the personal character of its retiring secretary."

IN the *St. James's Gazette* of November 17, "C. S." discusses the question as to the kind of winter we are to have, basing his arguments on a statement made by Bacon three centuries ago, that "a moist and cool summer portends a hard winter," and on the fact that severe winters have certainly occasionally followed wet or cool summers during the last century. The years particularly instanced are 1878, 1879 and 1880, which were followed by severe winters. The last severe winter was that of 1894–5, following a rather bad summer. The past summer bears considerable resemblance to that of 1879. We have occasionally referred to this subject, our remarks being chiefly based on Dr. v. Hellmann's discussion of the long series of Berlin observations. The results arrived at by Dr. Hellmann in a paper laid before the Berlin Academy in March, 1885, do not clearly support the views of "C. S.," so far as Berlin is concerned. Dr. Hellmann found that after a moderately warm summer a mild winter was probable, and, on the contrary, that a cold winter followed a warm summer.

OWING to illness, Mr. James Swinburne, president of the Institution of Electrical Engineers, was unable to be present at the opening meeting of the new session of the Institution, held on Thursday last. His inaugural address was therefore postponed. It was announced that Prof. Ayrton had, from ill-health and pressure of other business, resigned the honorary treasurership of the Institution, and that Mr. Robert Hammond had consented to fill his place. The council has had under consideration the continuance of the useful and pleasant visits of the members of the Institution to foreign countries, and has arranged the preliminaries for a visit to Italy in the spring of next year. The Institution has received a cordial invitation from the American Institute of Electrical Engineers to visit the United States and hold a joint meeting there or in Canada. The communication suggested that such a meeting might be arranged for Montreal next year, or at some spot in the eastern part of the United States in 1904, to include a subsequent visit to the St. Louis Exhibition, where an electrical congress will be held. The council has decided that as a meeting for next year could not be arranged, owing to the projected visit to Italy, the invitation for 1904 should be accepted. It was suggested at the same time that the joint meeting might be held in Canada, where the Institution might hope to receive the cooperation of the McGill University.

A REUTER message states that the *Morning*, which has been sent out as a relief ship to the *Discovery*, has arrived a Lyttelton, New Zealand.

PROF. J. WILLARD GIBBS, professor of mathematical physicst at Yale University, New Haven, has been elected a corresponding member of the Academy of Sciences at Munich.

A MEMORIAL tablet in memory of Richard Jefferies was unveiled at Swindon on Saturday by Lord Avebury. The tablet has been erected at the house where Jefferies lived for two years before his death.

PROF. J. MILLAR THOMSON, president of the Institute of Chemistry, and Miss Thomson, have issued invitations to a private soirée to be held at the Galleries of the Royal Society of British Artists on Wednesday, December 10.

THE Paris correspondent of the *Chemist and Druggist* states that the Paris Academy of Sciences has awarded the Lavoisier medal this year to Prof. Cannizzaro, of Rome, in recognition of his contributions to the advancement of chemistry.

THE new building of the Museum of Egyptian Antiquities at Cairo was opened by the Khedive on November 15 in the presence of Lord Cromer and Lord Kitchener, the Ministers, the Sirdar, and many European and native officials. The whole collection has been arranged in the new building under the supervision of the director, M. Maspero, and the curator, Emil Brugsch Bey.

A FEW particulars of the eruption of the Soufrière of St. Vincent which occurred on October 15 and 16 are given in extracts from despatches received by the Colonial Office. Sir R. B. Llewelyn, the Governor of the Windward Islands, remarks that there has been a largely increased area of land damaged by this last outburst, and the prospects are now much blacker than they were. It is suggested as a matter for serious consideration whether Georgetown, at present deserted, may not have to be abandoned; indeed, it is considered doubtful whether any part of the island can confidently be said to be without the range of danger from the volcano, and the possibility of abandoning the whole island has therefore to be faced.

REPORTS from Samoa published in the *Times* state that the volcano on the Island of Savaii is in active eruption. Several craters are emitting dust and vapour, and one village is two inches deep in ashes. Reports from Honolulu, dated November 11, state that, according to a wireless message from Hawaii, the volcano of Kilauea in that island has been in a state of the most violent eruption known for the last twenty years. A Reuter message from Catania states that a fresh eruption of Stromboli took place on November 16, and that incandescent stones, smoke and dust were thrown out. There was an explosion, followed by other silent eruptions, and a flow of lava. A shock of earthquake, accompanied by a loud rumbling noise and lasting five or six seconds, occurred at Oran, Algeria, on November 17, about 9.30 p.m.

AT Seville Cathedral on November 17, the ceremony of depositing the ashes of Christopher Columbus in a special mausoleum was carried out with impressive solemnity. The remains of Columbus rested for two centuries at Santo Domingo, and in 1796 were transferred to the Cathedral at Havana. After the Spanish-American war, they were taken to Spain, where, by desire of a descendant of Columbus, the Duke of Veragua, they have been interred in Seville Cathedral.

A REUTER message from Mantes, France, states that the navigable balloon constructed by the brothers Lebaudy made its first free ascent on November 3. Several ascents were made, the balloon returning to a given spot each time. It moved in all directions above the fields and woods which border the Seine. The report states that in every instance the airship was brought back to its starting-point at a speed of 25 miles an hour, the turn being made against the wind.

LARGELY with the idea of broadening the demand for German wares, Germany will take part in the Universal Exposition to be held in St. Louis in 1904. This decision has now

been officially announced. It is as yet unknown what sum of money is likely to be set aside for the purpose of the St. Louis exhibit, but from assurances given by the Emperor that every branch of German artistic, manufacturing, agricultural and industrial developments will be represented, it is supposed that 200,000*l.* will be devoted to the objects of the exhibit.

A MEETING of the executive committee of the Cancer Research Fund, under the direction of the Royal Colleges of Physicians and Surgeons, was held last week. Dr. Bashford, who has been appointed to the post of superintendent of cancer research, has decided to proceed at once to Germany to inquire into the present lines of investigation in that country, and to cooperate, as far as possible, with the German committee, especially in the direction of statistical investigation. The statistical committee which has been appointed will at once enter into correspondence with scientific workers in the United States, and Prof. Gilman, principal of the Carnegie Fund in Washington, has already expressed his willingness, through the chairman of the executive committee, to take joint action with the British committee, both in regard to statistical and laboratory investigation.

THE death of Mr. William H. Barlow, F.R.S., at the age of ninety, is announced in the *Times*. He was a distinguished civil engineer, well known as the designer of the St. Pancras Station and other large works upon the Midland Railway, to which he was consulting engineer. He was the son of Peter Barlow, F.R.S., who was professor of mathematics at the Royal Military Academy, Woolwich. Mr. Barlow inherited much of his father's mathematical ability, and his chief claim to recognition is that in the early days of railway engineering he endeavoured to introduce more scientific precision into the design of engineering structures. He was the inventor of a form of rail intended to dispense with the use of cross-sleepers. Jointly with Sir John Hawkshaw, he was engineer for the Clifton Suspension Bridge over the Avon. Mr. Barlow was the engineer of the new bridge over the Tay, built to replace the structure blown down in December, 1879, and was one of the committee of selection appointed to consider the designs for the new Forth Bridge.

THE Society of Arts commenced its 149th session on November 19 with a meeting at which an address was delivered by Sir William H. Preece, the chairman of the council, and the medals awarded by the Society during the past session were presented. At the next meeting, on November 26, Dr. Goegg will read a paper in French on the Simplon Tunnel and its effects on railway traffic to the East. At the other meetings before Christmas, there are to be papers on "Photographic Development," by Mr. Watkins; on "French Education," by Mr. C. Brereton; and on the "Russian Iron Industry," by Mr. Head. There will also be a meeting of the Indian Section, at which a paper on "Domestic Life in Persia" will be read by Miss Ella Sykes, who, with her brother, Major Molesworth Sykes, has had much experience of Persian travel. The Monday evenings up to Christmas will be devoted to a course of Cantor lectures on "Gas and Allied Illuminants," by Prof. Vivian Lewes.

WE learn from the *Times* that a meeting of the Stonehenge Committee, consisting of Lord Dillon, the Bishop of Bristol, Mr. Thackeray Turner, Mr. John Carruthers, the Rev. E. H. Goddard, Mr. N. Story Maskelyne, Mr. W. Gowland and Mr. C. H. Read, representing the Society of Antiquaries of London, the Wilts Archæological Society and the Society for the Protection of Ancient Buildings, was held at Burlington House this week. The committee received a report of the operations that had taken place under its advice, with the sanction and at the cost of Sir Edmund Antrobus, expressed approval of the steps already taken towards ensuring the safety of Stonehenge, and repeated its resolve that further steps must be guided by the determination to do as little as possible in order to save the monument for posterity. The committee is anxiously conscious of the fact that in the present state of Stonehenge there is grave danger of further accident. To meet the dangers of the present winter, it has now recommended the immediate application of wooden props to the stones about which the chief anxiety is felt.

UNDER the title *The Foreigner in Italy*, a new weekly paper has been started under the auspices of a new organisation founded last spring and styled the "National Association favouring the Foreign Element in Italy," 11 Piazza Barberini, Rome. The first number, bearing the date November 1, contains a notice of the ships which have been submerged in the lake of Nemi since the time of the Romans, and which it is proposed to raise by artificially draining the lake for the purpose. These ships, which were of the nature of floating palaces, have been examined on one or two occasions (1535, 1827, 1895), and explored by means of diving bells. One is 64 metres long and 20m. broad, and slopes down from 5m. to 12m. in depth at a distance of 20m. from the shore: the second is 71m. long, 21·4m. broad, and its depth is from 16m. to 22m., its distance from the shore being 50m. and from the first 200m. Further particulars have been given in numbers which have since appeared. The second number contains a short note upon the legendary origin of the name Pelée. The original Pelée is said by tradition to have been a maiden who was pursued by a giant and fled to the crater of the volcano for refuge. The gods of the volcano came to her assistance and overwhelmed the giant with lava, burying him beneath the rocks.

AN account of the mathematical work of Ernest de Jonquières is given in the *Bibliotheca mathematica*, iii. 3, by Prof. Gino Loria, of Genoa, who has also contributed a list of his papers and notes to the mathematical *Bolletino di bibliografia*, published by Clausen, of Turin. Jean Philippe Ernest Fauque de Jonquières was born at Carpentras on July 3, 1820, and died on August 12, 1901. His earliest recorded notes bear the date 1855, but from 1860 onwards he devoted himself for some time to the line of study opened up by Poncelet and Chasles, and in 1862 he was awarded two-thirds of the prize offered in connection with the study of curves of the fourth order. His mathematical writings, of which, including solutions to questions, 155 are enumerated, deal mainly with the following points: the higher geometry of Chasles, the theory of algebraic plane curves and systems, properties of algebraic gauche curves and surfaces, geometrical transformations and Eulerian polyhedra, theory of equations and theory of numbers.

IN the *Bulletin* of the Tokio Mathematico-Physical Society, Mr. T. Hayashi discusses the so-called "isosceles trapezium problem," according to which, if an ellipse be inscribed in an isosceles trapezium and circles are inscribed in the four corners, each circle touching the ellipse and two sides of the trapezium, then the radii of the four circles form a proportion. This problem has previously received attention from Japanese mathematicians. It looks as if a proof ought to be possible based on the property that tangents to an ellipse are proportional to the parallel diameters. Incidentally, it is proved that the points of contact of the inscribed ellipse divide the parallel sides proportionally; this is a simple corollary of the anharmonic property of four tangents.

REFERRING to a recent fatal accident caused by the unfortunate opening of one of the carriage doors of a train in motion, Sir Oliver Lodge, F.R.S., gives some sensible advice to passengers

in a recent letter to the *Times*. He points out that the door on the left of the traveller with his face towards the engine, with its hinge forward, is safe; but the door on the right, with latch forward, is very unsafe to open even slightly. The wind rushing by at hurricane speed gets into the opening, snatches the door wide open, thereby pulling the unwary passenger with his hand on the latch out on the line. If the door is six feet by three and the wind is exerting an average pressure of twenty pounds to the square foot, the force on the open door is as much as three cwts.

A RECENT issue of the *Scientific American* contains a description of the multiplex system of page-printing telegraphy described by the late Prof. H. A. Rowland. In this system, alternating currents are used for transmitting the signals, which are made up by suppressing different combinations of two half-waves in a series of eleven half-waves. The transmitting instrument has a typewriter keyboard, and four operators work over the same line; the messages sent by the different operators are separated by a commutator, which rotates in a quarter of a second and allows each operator to use the line for one-quarter of this period. In this way, with duplexing, 1920 signals or 320 words can be sent over one line in a minute. The receiving instrument prints the message on a sheet of paper, spacing it out into words and lines so that it appears like an ordinary typewritten sheet. It is said that the system has been successfully operated under the Government in America over a distance of 550 miles.

THE paper on "Electric Tramways" read by Messrs. C. and B. Hopkinson and E. Talbot before the Institution of Civil Engineers last week derives especial interest from the fact that it is based on the experience gained by the authors in the construction of the tramways at Leeds and Newcastle-on-Tyne. The chief points considered were the generation and transmission of power, the construction of rolling stock, and the vexed question of earth returns and electrolysis. It is interesting to note that the authors find that with seventy or more cars the load is so nearly constant that the steam consumption per unit is practically the same as for a constant load. In such a case, therefore, batteries are only needed as a stand-by or for night work. As regards electrolysis, it is stated that experiments showed that, except in special circumstances, the 7-volt Board of Trade limit might be exceeded many times without risk of damage to gas and water pipes, but if high conductivity strata existed at certain parts, there might be considerable damage caused by the leakage currents even below the 7-volt limit.

THE Report for the year ended December 31, 1900, of the Meteorological Service of Canada, compiled by the director, Mr. R. F. Stupart, has now reached us. The report consists of an introduction in which the Canadian observing stations are classified and the weather conditions summarised for each month of 1900. This is followed by separate parts, containing monthly and annual summaries for the chief stations; meteorological summaries for telegraph reporting stations; bi-hourly and hourly temperatures and barometric pressure during 1900; mean, maximum and minimum temperatures; rainfall and snowfall in 1900; and amount of bright sunshine registered in each month.

A STRIKING instance of the value of the work performed by meteorological observatories to those engaged in agriculture is contained in the last report of the chief of the U.S. Weather Bureau. On the morning of February 23, 1901, the following special warning was telegraphed from Washington to Jacksonville, Florida, with instructions to give it the widest possible distribution throughout the State. "Temperature will fall to-night to a minimum of between 20° and 25° at Jacksonville, and to freezing as far south as Tampa, with frost extending somewhat south of the latitude of Jupiter." Frost occurred as predicted, and the minimum temperature at Tampa was 32°. More than 500 telegrams were sent from the Weather Bureau office at Jacksonville, and the railroads of the State energetically cooperated in disseminating the warnings. Fruit and vegetable growers estimated the value of orange bloom, vegetables and strawberries known to have been saved, as a result of the warnings, at more than a hundred thousand dollars.

IN part iv. of vol. lxxii. of the *Zeitschrift für wissenschaftliche Zoologie*, Herr K. Hesse brings to a conclusion his valuable account of recent researches on the visual organs of invertebrates.

THE latest issue of Gegenbaur's *Morphologisches Jahrbuch* (vol. xxx. part iv.) contains a "symposium" on the morphology of the cloaca and certain of the reproductive organs of the amniote vertebrates.

IN the *Emu* for October, Mr. A. W. Milligan gives an illustration and description of the nesting-mound of one of the megapodes, the mallee (*Lipoa ocellata*). It appears that in hot weather the birds remove the top of the heap so as to form a saucer-like depression, which is again filled up when the weather becomes rainy. The author was fortunate enough to see the cock-bird performing the latter operation. A feature of this number of the *Emu* is the beautiful plate of the eggs and nest of the chestnut backed quail.

THE evidence as to the origin of the paired limbs of vertebrates forms the subject of an article by Prof. B. Dean in the October number of the *American Naturalist*. This evidence, it is urged, is strongly in favour of the view that paired limbs have been developed from skin-folds running along the sides of the body, as exemplified in the earliest and most primitive sharks. In the same issue, Prof. D. S. Jordan discusses the coloration of fishes, and concludes that, as in other vertebrates, some colour-types in this group serve for protection, others act as recognition-marks, while others, again, have been developed for sexual attraction.

WE have received the prospectus, together with an advance copy of the preface, of the long-expected work on the mammals of Egypt commenced by the late Dr. John Anderson and completed by Mr. W. E. de Winton, which promises to be of the highest value to naturalists. For many years before his death, Dr. Anderson had been assiduously collecting Egyptian mammals; but, even with the assistance of others, the series of specimens available to the authors, although very large, was not in all respects complete. Mrs. Anderson, who made all arrangements for the publication of the work and has supervised its contents, has herself contributed the preface. The price of the work, which is uniform with Dr. Anderson's "Reptiles of Egypt," has been fixed at seven guineas net.

THE *Illustrirte Zeitung* of September 18 contains a good figure of the aye-aye of Madagascar, taken from a specimen living in the Zoological Garden of Berlin. It is, however, quite incorrect when Dr. Heck, who writes the accompanying letterpress, claims that this is the only figure of this animal ever drawn from life. Prof. Owen's celebrated memoir on *Chiromys madagascariensis*, published in the fifth volume of our Zoological Society's *Transactions* in 1862, contains an excellent figure of this animal, taken from the specimen living in the Regent's Park Gardens in October, 1862, and drawn by the celebrated artist Joseph Wolf. There have been at various times *four* examples of the aye-aye living in the Zoological Society's Gardens, and its anatomy and osteology were elaborately described from them

by Owen forty years ago. Now our friends at Berlin are congratulating themselves because they have obtained a single individual, and are trying to make out that the animal has never been properly figured !

AMONGST the recent additions to the Zoological Society's reptile house are several specimens (deposited by the Hon. Walter Rothschild, M.P.) of the very curious large iguanoid lizard (*Conolophus subcristatus*) which inhabits the central islands of the Galapagos group, and the habits of which were described by Darwin in his "Naturalist's Voyage" (vol. iii. p. 469). It is a terrestrial species, and is stated by Darwin to be so numerous in certain districts that he and his companions could scarcely find a spot free from their burrows on which to pitch their tent. Closely allied to it is a large marine species of lizard (*Amblyrhynchus cristatus*), also confined to the Galapagos group, which lives exclusively on the rocky sea-beaches and is said "to go out to sea in shoals to fish." Living examples of the latter species were also brought away by Mr. Beck, Mr. Rothschild's collector, from the Galapagos, but, unfortunately, they did not reach England alive.

WE have received parts xii. and xiii. of the *Bulletin* of the Geological Commission of Finland, containing papers on the crystalline rocks of the country by B. Frosterus, and on a meteorite by W. Ramsay and L. H. Borgström.

THE *Transactions* of the Leicester Literary and Philosophical Society (vol. vii. part i., July, 1902) contain useful geological maps by Mr. Fox Strangways, on the scale of two inches to a mile, illustrating excursions made to parts of the Soar and Wreak valleys; and there is an instructive infra-Triassic map of Charnwood Forest by Prof. W. W. Watts. There is also a detailed report, with map, on the geology of the Beaumont Leys Estate, near Leicester, by Mr. Montagu Browne. Geology evidently flourishes in this Society under the enthusiastic leadership of Mr. H. A. Roechling.

FROM the New Mexico College of Agriculture and Mechanic Arts we have received *Bulletins* Nos. 42 and 43, in which Mr. J. D. Tinsley deals with the problem of alkali in the soil, and with drainage and flooding for its removal. Sodium carbonate is the essential constituent of "black alkali," as it appears to blacken the vegetable matter in the soil; while other salts of soda, as well as salts of magnesia and lime, help to form what is termed "white alkali" soil. It is pointed out by the author that the alkali is left in the soil by the evaporation of water that has gradually risen to the surface. When this excess of water is removed, the alkali will cease to accumulate and soon be washed out of the soil.

THE latest issue (1900–1901) of the *Proceedings* of the Royal Physical Society of Edinburgh contains a full report of the presidential address delivered by Mr. B. N. Peach in November, 1900, the subject of which is Scottish palæontology during the last twenty years. Full justice is done to workers in all branches of this science, while special attention is directed to the important service rendered by palæontological investigations to the task of unravelling the geological sequence in the Highlands. "The work done in Scotland during the period under consideration has thoroughly established the paramount value of palæontology in the interpretation of the geological structure of the country."

DR. G. T. MOODY describes a new "laboratory shaking machine" in the *Chemical News* of November 7. As a shaking machine capable of giving satisfactory results in the laboratory has long been sought by chemists, it is worth while to direct attention to that devised by Dr. Moody.

A SECOND enlarged and revised edition of "Das Wachstum des Menschen," by Dr. Franz Daffner, has been published by Mr. W. Engelmann, Leipzig (London: Williams and Norgate). The volume contains many interesting papers on the rate and character of the development of the different parts of the human body from embryonic stages to maturity.

IN the numbers of the *Journal* of the Society of Arts for October 17, 24, 31 and November 7 are reprinted the four Cantor lectures recently delivered by Dr. R. T. Glazebrook, F.R.S., on "Glass for Optical Purposes." The first lecture deals with the optical purposes for which glass is used and what it is that the glass used has to do. The defects of microscopes and the way in which they are cured or improved, chiefly by means of the use of glass of varying refrangibility and lenses of different curvature, are included in the second lecture; photographic lenses are considered in the third, and lenses for telescopes in the fourth lecture. Students of optics will find in the lectures a wealth of accurate and instructive information upon many points of interest.

SOME very interesting observations relative to the cause and nature of radio-activity have been recently made by Messrs. Rutherford and Soddy, an account of which is given in the September number of the *Philosophical Magazine*. The experiments were carried out with thorium compounds, all of which are radio-active. The authors arrive at the conclusion that the greater part of the radio-activity of thorium is due to a non-thorium type of matter, represented symbolically by ThX, possessing distinct chemical properties. The activity of this new type is not permanent, but undergoes a gradual process of decay, the value falling to one half in about four days. The constant radio-activity of thorium is supposed to be maintained by the continuous production of this new type of matter from the thorium compounds. Its rate of production and the rate of decay of its activity appear to be independent of the physical and chemical conditions of the system. The ThX is capable of exciting radio-activity on surrounding inactive bodies, and about 20 per cent. of the total activity of thorium is due to this action of the ThX. By suitable means, thorium can be freed from both ThX and the excited radio-activity produced by the latter, and then possesses an activity about 25 per cent. of its original value. This latter, the authors believe, is due to a second non-thorium type of matter.

THE additions to the Zoological Society's Gardens during the past week include two Chacma Baboons (*Cynocephalus porcarius*) from South Africa, presented respectively by Mr. C. S. Blundell and Captain P. J. Probyn, D.S.O.; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. J. H. Kirby; two Prairie Marmots (*Cynomys ludovicianus*) from North America, presented by the Countess de Grey; a White-collared Mangabey (*Cercocebus collaris*), a Rose-ringed Parrakeet (*Palaeornis docilis*) from West Africa, deposited; two Brown Pelicans (*Pelecanus fuscus*) from the West Indies, received in exchange.

OUR ASTRONOMICAL COLUMN.

CHANGE OF FOCUS IN THE LIGHT FROM NOVA PERSEI.—As previously recorded in these columns (July 3), Prof. E. E. Barnard made several determinations, during 1901, of the visual focus of the light from Nova Persei, in order to determine if the presence of the nebula lines in its spectrum produced the difference from stellar focus observed in the case of planetary nebulæ; his observations showed no decided difference of focus.

Observations made on July 14, August 29, September 1 and September 16 of this year produced a like negative result, and

the colour of the Nova was recorded as "a pale bluish white" on each occasion.

However, further observations, made on October 6, 7 and 14, indicate that the Nova has now assumed a bluer colour than hitherto observed, and that the visual focus is now about 0·2 inch greater than that of a star, that is to say, it now corresponds with the visual focus for planetary nebulæ. Prof. Barnard is certain that this change has taken place since August 29 of this year (*Astrophysical Journal*, vol. xvi. No. 3).

NEW MINOR PLANETS.—In No. 3826 of the *Astronomische Nachrichten*, Prof. Max Wolf records yet another batch of seven new minor planets, all of which were discovered, photographically, on October 25.

The planet 1902 K.E., discovered on October 25, has since proved to be identical with (19) Fortuna, the previously published ephemeris of which was incorrect. A new ephemeris is now given.

The minor planets (477) [1901 G.R.] and (478) [1901 G.U.], discovered by Dr. Carnera, have been named Italia and Tergeste respectively.

OBSERVATIONS OF THE AURORA.—A very interesting and valuable series of observations of the Aurora, which have been made at the Yerkes Observatory during the period 1897–1902, are recorded and commented upon by Prof. Barnard in the current number of the *Astrophysical Journal*.

The observations are recorded *in extenso*, and contain full details of the various phenomena attending the displays. Special notice is made of several interesting features, amongst them being the bank of apparent cloud which has a dark, smoky appearance and generally fills the space on the under side of the auroral arch. This cloud generally gives the appearance of being densely opaque, but that this is not the case is shown by the fact that the observations record the bright appearance of Vega as seen through the apparent cloud. The "pulsating clouds," which are generally 5° to 10° in diameter, are recorded as "fading out and quickly brightening again, as if someone were capriciously turning on and off their light." Another striking feature of the subject, which Prof. Barnard believes to be of importance, is the greatly varying altitudes of the summits of different auroræ, and these are carefully noted in the observations. The positions of the summits of various auroræ are generally recorded as being 20° to 25° east of north. A singular appearance—unique in Prof. Barnard's observations of these phenomena—was that of a quarter of an auroral arch on February 15, 1899, no other signs of auroral display being visible at the time.

The Yerkes observations of the grand aurora of September 10, 1898, which was accompanied by decided magnetic effects, describe it as the grandest display observed throughout the whole period, and state that the light in the north was so intense, at times, as to cast a distinct shadow.

As Prof. Barnard remarks, these observations, which cover a period of sun-spot minimum, will doubtless be important in their bearing on the connection between sun-spots and auroræ.

COOPERATION IN OBSERVING STELLAR RADIAL VELOCITIES.—Prof. E. B. Frost, having been struck by the fact that it is not possible to find, amongst published observations, a dozen stars the radial velocities of which have been determined at more than three different observatories, has sent a circular letter to the recognised workers in this field of astronomical physics asking them to join in a cooperative scheme for observing the radial velocities of the stars given in a mutually selected list.

All of the observers to whom the letter was addressed, seven in number, have agreed to the general scheme, and a primary list of about ten stars has been decided upon. Their programme, for the present, includes the making of three determinations of the radial velocity of each star in the list, per annum, by each observer (*Astrophysical Journal*, October.)

THE MARKINGS ON VENUS.—Prof. Percival Lowell, of Boston, has written to the *Astronomische Nachrichten*, No. 3823, suggesting that the spoke-like markings of the planet Venus are not really present on the surface of the planet, but that their appearance is due to an optical effect produced by the eye wandering from the dark indentations which are seen along the terminator, and the smaller spots and streaks, to the centre of the disc. To test this theory, Prof. Lowell has observed a large number of artificial discs, marked without his knowledge, and set up at a distance so as to be, as nearly as possible, under the same observing conditions as the planet.

These experiments tend to prove his theory, but are not sufficiently decisive to place the non-objective existence of these peculiar markings beyond doubt; therefore Prof. Lowell, for the present, only enters a caveat against the acceptation, as a fact, of their real existence.

THE NERNST LAMP.

THE Nernst lamp can now be said to be well upon its way from the experimental to the commercial stage. It has appeared strange to many people that it has taken such a long time before lamps could actually be bought for use, but a critical examination of the lamps now to be had causes one to wonder, not that its development has taken a long time, but that it has been possible to practically develop it at all. Of all artificial methods of illumination it is the most complicated, and its various auxiliary parts are in themselves inventions requiring for their inception no ordinary genius and perseverance. The Nernst lamps now to be had in England are made by the Allgemeine Elektricitäts Gesellschaft of Berlin. The only other manufacturer of Nernst lamps is the Nernst Lamp Company of the United States, which has acquired the rights for that country. The demands of the rest of the world are being supplied by the A.E.G., the agent of whom for the British Colonies, Asia, Africa and South America is the Nernst Electric Light, Limited, of London, which, in the form of an attractive

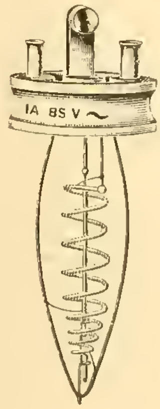


FIG. 1.

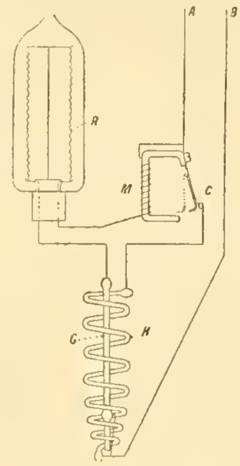


FIG. 2.

pamphlet, has just issued a description of the various lamps it is prepared to sell.

The lamps are of two types and are rated by current, not, as is usual with incandescent lamps, by candle-power, viz. 0·25, 0·5 and 1·0 ampere lamps. The watts consumed per candle-power are about 1·8.

The larger lamp used for all high candle-powers, *i.e.* 50 candle-power and upwards, consists of three parts, the carrier, the lamp body and the globe. The current is led into the lamp body by insulated plug contacts, on the withdrawal of which the lamp is rendered entirely dead and can be handled with safety. The lamp body contains the magnetic cutout for interrupting the current through the heater, after the glower has lighted up, also the series resistance. The contacts for the replacement piece are also carried by the lamp body. This is shown in Fig. 1, and consists of a round piece of porcelain on which are fixed the heater and glower. The general connections of the lamp, as also the functions of its several essential parts, can be seen by reference to Fig. 2. On first switching on current to the lamp, the circuit is closed through the armature and contact C of the cutout M, and through the heater H. The heater is a marvel of ingenuity. It consists of an exceedingly fine platinum wire wound on a rod of porcelain, the rod being in the form of a spiral in the axis of which the glower G is placed. The method of manufacture adopted is to wind the straight rod with the wire, then to cover

this with a protecting layer of porcelain paste and after drying to bend the whole into spiral form by means of a blowpipe. The glower, which is composed of a mixture of zirconium oxide with the yttria-erbia oxides, is, of course, while cold a non-conductor of electricity. Heated, however, by the heater it begins to conduct, rendering itself hotter by its own current energy, getting hotter and hotter until it reaches its normal brilliant state of incandescence. The glower current flowing through the coils of the cutout magnetises the same, causing it to pull in its armature and break the heater current at C.

An unfortunate feature of the Nernst glower is that at the necessary state of incandescence the voltage across it decreases with increase of current. If one wished to express this mathematically, one would say its $\delta v/\delta a$ (v = volts, a = amperes) is negative. A conductor possessing this property placed across supply mains of constant voltage is, however, in an unstable state of equilibrium and will not burn properly. The function of the series resistance R is to correct this. This consists of a very fine iron wire placed inside a glass bulb containing hydrogen gas at low pressure. The thickness of the iron wire is so chosen that at the normal current it is just at its critical stage, *i.e.* at that point, just under the red heat, where its $\delta v/\delta a$ is highly positive; the instability of the glower by itself is thus compensated and the whole glower circuit across the mains is rendered stable.

The smaller lamp, used for all candle-powers below fifty, consists of essentially similar parts to the larger model already described.

As to the economy of the Nernst lamp, the following table shows the result of a test carried out by the Physikalische Technische Reichsanstalt, of Berlin:—

Mean of five lamps. Pressure 220 volts.

Time (hours).	Candle-power.	Watts per candle.
0	35·1	1·65
50	32·4	1·77
100	32·3	1·77
200	30·1	1·85
300	27·5	1·93
400	26·5	1·97
Mean during 400 hours	30·1	1·83

The average life was 380 hours. The heaters were not damaged.

Unfortunately, no information is given as to the source of supply on which these tests were made. Experience already acquired shows that this is of great importance as determining the life of the glowers. Of course, on the basis of 1·8 watts per candle, for a life of 400 hours, the Nernst lamp works out at a saving of about 40 per cent., first cost and renewals included, over ordinary incandescent lamps.

We believe that the lamp is finding, or will find, considerable commercial application, and we anticipate for it a very useful and prosperous future.

C. C. Garrard.

NATURAL PROPORTIONS IN ARCHITECTURE.[1]

It is well known that formal decoration must be based upon exact geometrical construction. The history of art and architecture shows that the most beautiful buildings and formal ornamental *motifs* are those depending upon definite and regular principles. The symmetry of architecture consists of the rhythmical repetition of certain parts of a design in relation to a plan or scheme as a whole, or uniformity as regards the answering of one part to another. The symmetrical forms of Nature have the same interdependence of detail. If a flower is examined which possesses a definite and unmistakable symmetrical adjustment of part to whole, it will furnish a case in point. If even a glimpse could be obtained of the manner in which Nature made the adjustment of her detail, it seemed not unreasonable to expect that the principles involved would be of assistance to design. Even a casual examination showed that much of the harmony of relationship of parts in regular objects could be expressed graphically by geometrical lines. It was found by experiment that this expression was very simple. In most cases, a few circles described concentrically would entirely satisfy zones of symmetry involved in some forms. In addition to the formal plans disclosed in plants, with their leaves, flowers and fruit, the author investigated the beautiful curves of the wings and bodies of butterflies, beetles, moths and bees. He found that in all such examples, these curves were best satisfied by the tangent arcs of circles which had their radii determined by a simple ratio. This ratio almost invariably was a double or binary one, the unit being obtained from the length of the subject's body. With such a unit as a radius, a circle would be described; the diameter of it would be taken as a radius for another, the radius of this for still another, and so on. This progression would be continued until enough arcs had been secured to satisfy all the curves involved. The tangent arcs of circles so related would satisfy these curves, so that it would be impossible for the eye to detect any difference between the approximated and the actual form.

The circles used to satisfy curves of natural objects in this manner may be termed binary circles. They are really circles having radii which form a geometrical progression with a ratio of two. By describing these binary circles concentrically, many proportions involved in the plans of certain forms were accounted for. There were other proportions, however, which these circles did not explain, but the three simple figures which compose the regular polyhedra are involved in the construction

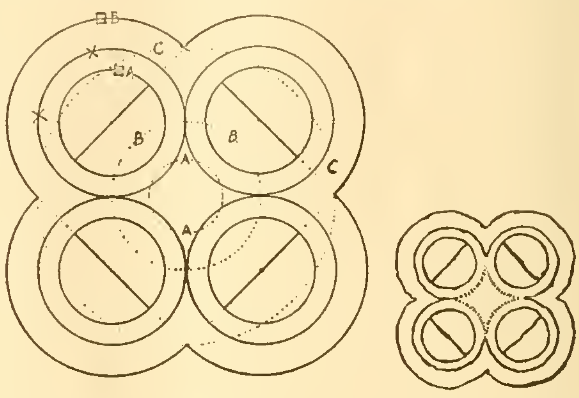


Fig. 1.

A A Primary Circle 1.
B B ,, ,, 2.
C C ,, ,, 3.
□ A Circle 1 derived from □ in A.
□ B Circle 2 ,, ,, □ in A.
× = □ in Circle A.
The symmetry expressed formally.

Cross section of young fruit and contained seeds of the verbena.

to satisfy them. There are but five possible regular polyhedra, and the three simple figures which compose their faces are the equilateral triangle, the square and the regular pentagon. Once having obtained the primary circles, these simple regular figures may be inscribed in any one of a binary series and a side of each used as a radius to describe others concentrically.

With this simple geometrical formula, it is possible to account for every possible combination of symmetry and proportion. Snow crystals and mineral crystals furnished, so to speak, the converse aspect of the curved forms of organic nature. The straight lines used in the graphic expression of the form of a crystal of any system may be shown to be connected with circles such as have been described. The precision with which this formula analyses the symmetrical shapes of Nature is very remarkable.

If the master architects and decorative artists of the past were guided by Nature, we ought to find an agreement between the proportions of curve and straight line which they employed in their plans and the plans of regular natural objects. This is exactly what a general analysis of architecture and formal art has disclosed. As the designer has used good or bad proportions in his architectural and decorative compositions, there may be found, by this method of analysis and comparison, harmony with the proportions which Nature employs.

The fact that the simple figures of the polyhedra are involved in all symmetrical forms of Nature has naturally suggested that their proportional properties be investigated. If these figures are considered as representing elements of symmetry and the

[1] Abstract of a paper read before the Hellenic Society on November 4 by Mr. Jay Hambidge.

peculiar manner in which they lend themselves to subdivision or multiple expansion is examined, it will be seen that they are inseparably connected with circles which have their radii related in the manner described. Study of these figures will enable one to tell, by merely looking at a proportioned object, the order of its symmetry or character of its plan. For instance, in a cross-section of the young fruit and contained seeds of the verbena, certain circles are involved in relationship to a square. Without making any measurements from the fruit, the plan can be accurately formulated (Fig. 1).

This construction is simple, but it involves principles which are far-reaching. The ground plan of the Parthenon is an instance of architectural construction where the detail is co-ordinated in much the same manner.

The basal projection of the crystal of topaz (Fig. 2) involves all the proportions which occur in regular forms. There are the primary circles the radii of which form the geometrical progression with the binary ratio, and the secondary circles as derived from the sides of the equilateral triangle, the square and the regular pentagon. This example also includes the odd proportion derived from the perpendicular of an equilateral triangle. This

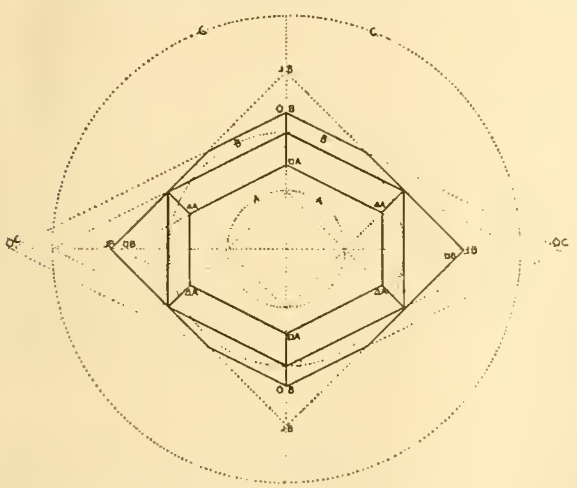


FIG. 2.—Crystal of topaz—basal projection.

A A Primary circle 1.
B B ,, ,, 2.
C C ,, ,, 3.
Distance of point □ A from centre determined by □ in A.
,, ,, △ A ,, ,, ,, △ in A.
,, ,, B ,, ,, ,, in B.
,, ,, □ B ,, ,, ,, □ in B.
,, ,, ⅃ B ,, ,, ,, ⅃ in B.
,, ,, ⬠ C ,, ,, ,, ⬠ in C.

This crystal base contains the entire scheme of proportion and symmetry as found in the Parthenon.

is the only proportion found in symmetrical natural form which seems to be connected with an arithmetical progression.

The Greek and Gothic styles of architecture furnish the most satisfactory results in a comparison of their curves and proportions with the curves and proportions of natural symmetrical forms. In the finest example of the former, the Parthenon, the agreement is so extraordinary that all its proportions and curves may be obtained with no other instrument than a string and a couple of sticks. A surface of levelled earth would furnish a place to make the simple constructions. The beautiful curves found in this building, which so simulate those of conic sections as to deceive the expert mathematician, can be accounted for by this method. In fact, there is no curve in Greek formal art which may not be simply, rapidly and accurately drawn with a compass, and when so drawn, the circles used will be found to possess a definite relationship one to the other. This method would seem to furnish a simple explanation as to how the Greek architects used these curves so long before their supposed discovery. The agreement between the plans of the regular forms of Nature and the plans of the best buildings would seem to suggest that the great architects possessed a formulated or intuitive knowledge of simple principles of proportion which are unknown to us.

[1] ⅃ is the symbol for the perpendicular of the equilateral triangle.

EARTHQUAKES AND EARTH PHYSICS.

PROF. J. MILNE, F.R.S., read a paper on "World-shaking Earthquakes" before the Royal Geographical Society on November 11. In the course of his paper, he remarked that earthquakes may be divided into two groups—first, those which disturbed continental areas, or even the world as a whole, which he called macroseismic, and, secondly, local earthquakes disturbing a few miles' radius, or not more than 100 or 200 miles, which he called microseismic. Evidence of the existence of large earthquakes was sometimes afforded, even though they could not be felt; for example, in 1755, the motion of the water in lakes and ponds observed in England, Scandinavia and North America was attributed to the earthquake at Lisbon. Another form of evidence was sometimes discovered by astronomers, as in May, 1877, M. Nyrén observed disturbances in the level of the axis of the transit at Pulkova, which were held to be due to an earthquake about an hour and a quarter earlier at Iquique. The first instrumental record obtained by the writer of an earthquake which could not be felt was in March, 1884. This and others were referred to as "slow earthquakes." A long series of observations justified him in saying, in 1883, that every large earthquake might be recorded at any point on the land surface of the globe. Thus a new field was open to seismologists, and recording stations were now to be found in many countries, the most complete organisation working in connection with a committee of the British Association. A large earthquake seemed to propagate a series of waves in all directions through and in all directions over the world's surface. Describing in detail the character of this motion, he said that the large waves of earthquakes seemed to pass beneath a country like ours with the character of an ocean swell. The character of these waves was still in process of investigation, and there were reasons for and against any conclusions which might be reached. It would appear that the effective rigidity of the world was about twice that of steel, and it was easy to measure the difference in time between the arrival of preliminary tremors and of large waves—the former reaching a place 80° from their origin in about fifteen minutes, whilst large waves took about fifty minutes. From these differences in times of arrival of different waves, distances of origins could be obtained, and from the distance ascertained from several distant stations the origin might be easily located. Another method of ascertaining origin was the difference of the times of arrival at different stations of large waves, and by these methods the origin of the world-shaking earthquakes for 1899, 1900 and 1901 had been determined. Prof. Milne established a relationship between the distribution of the origins of large earthquakes and the pronounced irregularities of the surface of the earth by a number of illustrations taken from the Alaskan region, which had yielded large seismograms to the Cape of Good Hope, which was antipodean to Alaska, the Cordillerean region, the Antilles, the Andes, Japan, and other parts of the world. He also gave an historic account, dating from 1692, of the mass displacements which had been caused by great earthquakes. As examples, in 1855, in New Zealand, 4600 square miles were raised 1 foot to 9 feet; and in 1897, in Assam, according to Mr. R. D. Oldham, 10,000 square miles of country were displaced possibly 16 feet along a thrust plane.

The connection between large earthquakes and volcanic activity was considered; and instances were given of the seismic convulsions which apparently resulted in reliefs of volcanic strain. So recently as the early part of last summer, the symptoms of volcanic and seismic activities in the Western Hemisphere culminated in the terrible explosions in Martinique and St. Vincent. Prof. Milne also gave the result of inquiries into the relationship between world-shaking earthquakes and unusual movements of magnetic needles. At certain stations, the unfelt waves of large earthquakes disturb magnetic needles, but this is not the case at all stations. This difference in behaviour is not explicable on the assumption that the movements are due to tilting of the instruments, but it is possible that they may be due to magnetic influences. The stations at which movements are observed, Prof. Milne suggests, may be nearer to the magma in which the large waves are propagated than the other stations where movements are not observed. Inasmuch as this magma is not only magnetic, but is also dense at the former stations, the observed value for g would exceed that at the remaining stations, *caeteris paribus*. In support of this view, figures were adduced. References were made to small changes in latitude. When

these were pronounced, world-shaking earthquakes had been frequent. A comparison of the varying number at different periods of small earthquakes showed that the number recorded increased; but this was evidence, not of the growth of seismic activity, but of more general observation. Nearly all large earthquakes were followed by a long series of after-shocks. For example, after the disturbance of October 28, 1901, which had its origin in Central Japan and which might be regarded as a typical world-shaking earthquake, during the first twelve months, 2956 shocks were noted. Next year the number fell to 391. The conclusion seemed to be that in any given year there were 27,500 shocks which could be recorded in epifocal districts, and that, on the average, there annually were 30,000 small earthquakes. From seismograms obtained in epifocal areas, measures of earthquake energy had been obtained. The result was that engineers and builders were now able to build to withstand known forces, and in Japan, in particular, effectual methods had been adopted to resist the severe shakings to which that country was subject. The Japanese Government had so far recognised the importance of seismology as to establish professorships to encourage its study.

THE ROYAL PHILOSOPHICAL SOCIETY OF GLASGOW.

NOT many scientific societies of the kingdom can boast of having existed for a hundred years, but the Royal Society of Edinburgh a few years ago celebrated its centenary, and last week what is now known as the Royal Philosophical Society of Glasgow was engaged in celebrating the attainment of its hundredth year, for it came into being on November 9, 1802, with sixty-two of the most prominent men in the city as members, many of whom have since acquired prosperity and reputation. There was Dr. William Meikleham, the professor of astronomy and natural philosophy in the University, and who was Lord Kelvin's predecessor in the natural philosophy chair, so that those two men practically covered the century between them. There was also Dr. George Birkbeck, subsequently a professor in the "Andersonian," and the founder (in London) of mechanics' institutions. Patrick Cumin, another foundation member, was the professor of Oriental languages. A particularly notable man in the membership was David Mushet, the discoverer of the famous blackband ironstone which did so much to make Scotland the leading element in the creation of the iron industry. Among other original members were Charles Macintosh, who originated the "macintosh" as an article of clothing for wet weather; Mr. John Roberton, a famous iron-founder, who read many papers in subsequent years; and Mr. William Dunn, of Duntocher, a well-known machine-maker. Mr. James Boaz was an accountant; he took a warm interest in the Society, and became secretary in the year 1804, remaining in that office to the great credit of the Society for twenty-six years. Sundry other original members might be named and descanted upon, men from the very highest ranks, and who collectively made Glasgow or contributed very materially towards it, but we must refrain from doing so. Worthy John Geddes, of Verreville, glass manufacturer and potter, was an early member, and he was the second president. The Society did not publish any *Proceedings* or *Transactions* until the year 1844, after Dr. Thomas Thomson, F.R.S., had become president. That gentleman was the famous professor of chemistry in the University, and his knowledge was frequently called forth during the eighteen years that he held the office of president. Mr. Walter Crum, F.R.S., famous as a scientific calico printer, succeeded Dr. Thomson in the chair, and then there was a somewhat continuous run of University presidents, such as Dr. Allen Thomson, F.R.S., Prof. Wm. Thomson, F.R.S. (now Lord Kelvin), Prof. Thomas Anderson (distinguished as a chemist), Prof. W. J. Macquorn Rankine, C.E., F.R.S., and Prof. Henry D. Rogers (American geologist). After he had been knighted, the professor of natural philosophy was again made president for the years 1874-75-76-77. The Society was always in a position to command the services of able and learned men to take the presidential chair, and business men have always been in abundance to fill the executive offices and to discharge the duties pertaining to them for periods extending from six years (in the case of Prof. McKendrick as secretary) to upwards of thirty years, as in the case of Mr. John Mann, the present treasurer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An Isaac Newton studentship in physical astronomy and optics, of the value of 200*l*. a year for three years, will be awarded in the Lent term, 1903. Candidates must be Bachelors of Arts who are under twenty-five years of age on January 1, 1903.

IT is announced that a chair of tropical medicine has been founded in University College, Liverpool, with an endowment of 10,000*l*. Major Ronald Ross, C.B., F.R.S., has been elected to the chair.

SIR OLIVER LODGE, F.R.S., was on November 14 entertained at the annual dinner of the Liverpool Philomathic Society, when he delivered an address. He said his removal to Birmingham was solely because of the greater opportunity for his own work which his position in that city afforded him. Speaking of universities, he remarked that the competition among cities to make themselves worthy to become the seat of a university was healthy and holy, and he trusted the movement for establishing a university for Liverpool was gaining ground.

THE second subsection of Clause 18 of the Education Bill, as amended in Committee of the House of Commons on Friday last, lays it down that "the power to provide instruction under the Elementary Education Acts, 1870 to 1900, shall, except where those Acts expressly provide to the contrary, be limited to the provision of instruction given under the regulations of the Board of Education to scholars of not more than fifteen years of age in a public elementary school, but any scholar may remain in such a school to the close of the school year in which he or she reaches the age of fifteen." The difficulty which has existed for some time of defining what constitutes elementary education is thus in a large measure disposed of. An attempt was made to remove the age limit and so allow it to be possible for a child to stay at an elementary school so long as the parents wished. But the intention of the Government appears to be to encourage the drafting of children of capacity into secondary schools, and in this way to reduce expense and also prevent overlapping.

AT the invitation of the University of Cambridge, representatives of all the universities of England and Wales, of the numerous educational associations concerned with secondary education, as well as of the Board of Education, assembled in the Senate House at Cambridge on November 14 and 15 to confer as to the training of teachers in secondary schools for boys. Among men of science who took part in the interesting debates, following the papers on different subjects requiring consideration, were Prof. H. E. Armstrong, F.R.S., Sir Oliver Lodge, F.R.S., Prof. John Perry, F.R.S., and Sir Arthur Rücker, F.R.S. The Vice-Chancellor of the University presided at both meetings, and among the papers, those of Sir Richard Jebb, Mr. Sidgwick and the Master of Marlborough were of particular importance. As Sir John Gorst, whose speech concluded the proceedings, pointed out, if the universities intend to remain at the head of this movement for obtaining suitable training for the masters in secondary schools, they must be progressive and make use of the best of the methods which experience has shown to be suitable to the new demands. One such method, he pointed out, is that by which science is studied by research carried on by the pupils.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, November 13.—Dr. E. W. Hobson, president, in the chair.—The De Morgan medal for 1902 was presented to Prof. A. G. Greenhill.—Mr. Tucker having retired from the office of secretary, the following resolution was proposed by Dr. Hobson, seconded by Dr. Glaisher, and carried unanimously:—"That the thanks of the London Mathematical Society be offered to Mr. Robert Tucker for the eminent services which he has rendered to the Society during the thirty-five years in which he has held the office of honorary secretary."—The council and officers for the ensuing session were elected. They are as follows:—President, Prof. Lamb; vice-presidents, Mr. Tucker, Dr. Hobson, Dr. Baker; treasurer, Dr. Larmor; secretaries, Prof. Love and Prof. Burnside; other members of

the council, Mr. Campbell, Lieut.-Colonel Cunningham, Dr. Glaisher, Prof. Greenhill, Mr. Macdonald, Major MacMahon, Mr. Western, Mr. Whittaker, Mr. A. Young.—Prof. Lamb having taken the chair, Dr. Hobson delivered an Address on the infinite and the infinitesimal in mathematical analysis. He sketched briefly the history of the attempts that had been made at various times to deal with questions of the infinite, and dwelt especially upon the critical work of the latter half of the nineteenth century, pointing out that pertinent criticism of fundamentals almost invariably gives rise to new construction. He explained how the system of analysis, connected with the title "arithmetisation," had turned a difficulty, to which all previous systems were liable, in that they were unable to give a proof of the existence of the limit. He described the character of the numerical continuum, and contrasted its properties with those of other aggregates, which possess unlimited divisibility. He proceeded to recount the objections that had been raised to the introduction of infinite numbers, as opposed to variables which become indefinitely great; and he concluded with an outline of the theory of transfinite numbers.—The following papers were communicated:—Prof. D. Hilbert, Ueber den Satz von der Gleichheit der Basiswinkel im gleichschenkligen Dreieck. The paper forms part of a critical discussion of geometrical axioms. The possibility of setting up various systems of axioms, so that the axioms of a system shall be mutually consistent and mutually independent, has been proved; and it becomes important to ascertain the relations of the more fundamental geometrical propositions to the possible systems of axioms.—Prof. Burnside, On linear homogeneous groups. The characteristic determinants of any simply transitive, and of any transitive, linear homogeneous group are discussed, and general forms of the determinants are given; the results are applied to simplify the proofs of known propositions concerning the continuous group that is defined by any given group of finite order.—Prof. Lamb, On wave-propagation in two dimensions. The divergence, in two dimensions, of waves from a source, of a more or less transient character, is worked out in detail and illustrated graphically. The disturbance begins suddenly at a place when the wave reaches it; but it does not cease suddenly after a time equal to that during which the source is in action. The existence in two-dimensional wave motion of a sort of "tail" to a wave, which does not occur in the case of waves in one dimension or in three dimensions, is further elucidated by various comparisons between the characters of the three cases.—Prof. A. C. Dixon, (1) Summation of a certain series; (2) Expansions by means of Lamé's functions. The first of these papers is a development of previous work by Morley on the hypergeometric functions that arise from the consideration of the sum of the cubes of binomial coefficients. The second paper contains a discussion of the use of Lamé's functions to determine a potential from its singularities and boundary values for the following regions:—(*a*) the interior of an ellipsoid, (*b*) the exterior of an ellipsoid, (*c*) the space between two confocal ellipsoids, (*d*) two distinct regions, bounded by confocal ellipsoids, wholly or partly coextensive and connected together through the area of the focal ellipse.—Mr. W. H. Young, (1) On sets of intervals, (2) Note on unclosed sets of points defined as the limit of a sequence of closed sets of points. The first of these papers aims at developing the theory of sets of intervals on the straight line in a systematic manner; it is pointed out that, although the discussion of such sets forms a natural introduction to some parts of the theory of aggregates, only a few isolated theorems about such sets have been formulated hitherto. The object of the second paper is to obtain the necessary and sufficient condition that the content of the set obtained by closing an unclosed set, which is the limit of a sequence of closed sets, may be the limit of the contents of the closed sets of the sequence.—Prof. Hill, The continuation of certain fundamental power series. The object of the paper is to illustrate the theory of continuation in simple cases in which the work need not be artificial. The continuations, along arbitrary circuits, of the binomial series, the logarithmic series, the series for arc tan x, are developed in detail. The methods of the paper depend upon theorems proved by Abel in his classical memoir on the binomial series.—Prof. L. Crawford, A geodesic on a spheroid and an associated ellipse. The length of the arc of a geodesic drawn from a given point on a spheroid in a given direction is found as the length of an arc of an ellipse, and the difference of longitude of any point on the geodesic and the given point is expressed as an elliptic function of an angle connected with the corresponding points on the same ellipse; an expression is found for the change in longitude on return along the geodesic to the same latitude.—Prof. A. W. Conway, The propagation of light in a uniaxal crystal. New forms of integrals of the equations of propagation are obtained. The results are applied to the discussion of the direction of vibration and the flow of energy; it appears that the ray direction is not the direction of the energy flux in waves diverging from a source within the crystal. Applications of the integrals are also made to discuss the passage of parallel and of divergent beams of light through a thin crystalline plate.—Mr. E. T. Whittaker, On a new connection of Bessel functions with Legendre functions. A symbolic relation, which connects the functions in the case where the order of the Bessel functions is half an uneven integer, is transformed into an expression for the Bessel functions of unrestricted order as definite integrals involving Legendre functions of unrestricted order.

Chemical Society, November 6.—Prof. McLeod, F.R.S., in the chair.—The following papers were read:—The specific heats of gases, by Mr. H. Crompton. An extension of the application of Le Chatelier's formula for the specific heats of elementary gases to the vapours of complex substances.—The action of nitric acid on bromophenolic compounds, by Mr. W. Robertson. An investigation of the effect produced by displacement of the hydroxyl group by methoxy- or acetoxy-groups in inhibiting the replacement of bromine by nitroxyl.—3:5-dichloro-*o*-xylene and 3:5-dichloro-*o*-phthalic acid, by Drs. Crossley and Le Sueur.—The combination of carbon monoxide with chlorine under the influence of light, by Drs. Dyson and Harden. These gases when dried, mixed in equal quantities and exposed to light, undergo first a period of photochemical induction and finally reach a stage of equilibrium with the carbonyl chloride formed.—The constituents of commercial chrysarobin, by Dr. Jowett and Mr. Potter.—The constituents of oil of rue, by Dr. Power and Mr. Lees. The following new constituents have been obtained:—methyl *n*-heptylcarbinol, methyl *n*-nonylcarbinol, methyl salicylate, cineol, limonene and pinene.—Methyl β-methylhexyl ketone, by Mr. H. Lees.—Diindigotin, by Dr. Moir. This substance was obtained by the application of Baeyer's process for the synthesis of indigotin from *o*-amidocinnamic acid to the diphenyl analogue, benzidine dicarboxylic acid.—The localisation of phosphates in the sugar-cane, by Mr. Sprankling.—On the non-existence of the gaseous sulphide of carbon described by Deninger, by Messrs. Russell and Smith.—Isometric anhydrous sulphates of the form $M''SO_4,R'SO_4$, by Mr. F. R. Mallet.—The catalytic racemisation of amygdalin, by Dr. J. W. Walker. The optically active glucoside is converted by the hydroxyl ions of aqueous alkaline solvents into racemic amygdalinic acid.—On asymmetric optically active selenium compounds, and on the hexavalency of selenium and sulphur, by Prof. Pope and Mr. Neville. Methylphenylselenetine has been obtained in dextro- and lævo-modifications by fractional crystallisation of the *d*-bromcamphorsulphonate.—The transformation of acetylchloroaminobenzenes into the isomeric chloroacetanilides, by Drs. Chattaway and Orton.

PARIS.

Academy of Sciences, November 10.—M. Albert Gaudry in the chair.—On uniform transcendentals defined by the equation $y'' = 6y^2 + x$, by M. Paul Painlevé.—On quasi-waves, by M. P. Duhem. From the theoretical examination of the velocity of propagation of sound waves in air, it is shown that if the coefficient of conductivity has a finite value, however small, the waves will be propagated in accordance with the formula of Newton, and it is only in the case where the conductivity coefficient is rigorously zero that the waves will travel in accordance with the formula of Laplace. But although the conductivity of air is small, it is not zero, and this leads to a serious discrepancy between theory and experiment. The author shows that the existence of viscosity in air, although small, renders impossible the propagation of waves properly so called, and examines the conditions of transmission of the quasi-waves which are possible, and succeeds in showing that an explanation of the discrepancy becomes possible.—Further observations and experiments relating to the determination of the velocity of the X-rays, by M. R. Blondlot. According to the theory put forward by Wiechert and Sir G. G. Stokes, the X-rays consist, not of continuous ether vibrations, but of extremely short, isolated pulsations, and this hypothesis has been shown to give a complete explanation of the absence of refraction and reflection and of the diffraction phenomena shown by the rays. All the experimental results obtained by the author are also in accord

with this hypothesis, which appears to render a complete account of all the facts at present known.—Study of the climate of Toulouse from 1863 to 1900, by M. B. Baillaud.—Remarks by M. Haton de la Goupillière on a recent paper by M. Gréhant on the analysis of air from mines.—On the present condition of the volcano at Mont Pelée, by M. A. Lacroix.—Gravity along the mean parallel, by M. J. Collet.—On Cremonian substitutions in space, by M. Léon Autonne.—On the breaking and displacement of equilibrium, by M. Jouguet.—On the equivalence of differential systems, by M. E. Cartan.—On certain remarkable equalities, by M. W. Stekloff.—On Hall's phenomenon and thermoelectric power, by M. Edmond van Aubel. According to the views of Nernst and von Ettingshausen, there should be a relation between the thermoelectric power and Hall's phenomenon in metals. It was found by Becquerel that certain alloys of bismuth and antimony and a mixture of bismuth with bismuth sulphide possess very high thermoelectric power, and these have now been examined by the author with respect to the magnitude of the Hall effect. The results confirmed the theory of Nernst and von Ettingshausen.—On the conductivity of solutions at low temperatures, by M. J. Kunz. The electric conductivities of solutions of sulphuric acid have been determined at temperatures between 0° C. and −70° C. The conductivity does not vanish at −39°C., as had been suggested by Kohlrausch, but diminishes continuously with the temperature.—Some new experiments on the electrical resistance of selenium and its application to the transmission of luminous images and impressions, by M. Dussaud.—The artificial production of rubies by fusion, by M. A. Verneuil. The exact conditions necessary for the production of artificial rubies have now been worked out, and specimens have been obtained possessing a fine red fluorescence, and which have been found by the lapidaries employed to cut them to possess the same hardness as natural rubies, and to take the same fine polish. Occasionally, rubies have been made which it is impossible to distinguish from natural ones, but as a rule there are slight faults which can be made out on careful examination.—On the alloys of copper and magnesium, by M. O. Boudouard. The fusing points of a series of alloys of copper and magnesium, when arranged on a curve, give three maxima and four minima. The former correspond to the existence of three definite alloys, $CuMg_2$, CuMg and Cu_2Mg. The mechanical properties show a general parallelism with those of the aluminium-copper alloys, studied by Debray.—On the presence of volemite in some Primulaceæ, by MM. J. Bougault and G. Allard. The polyatomic alcohol, extracted from the roots and rhizomes of *Primula grandiflora*, and previously described as primulite, has now been recognised as identical with the volemite of Bourquelot and E. Fischer.—Study of the chemical composition of copal, by M. Marcel Guédras.—On the grouping of crystals of different species, by M. F. Wallerant.—On the development of the ovule in the Asclepiadeæ, by M. Paul Dop.—On the Nubian Sandstone, by M. R. Fourtau.—On the nature of the electric currents of the nerve, by M. B. E. Wedensky.—The *rôle* of the adipogenic function of the liver in the invertebrates, by Mlle. C. Deflandre.—On the existence of arsenic in the animal kingdom, by M. Gabriel Bertrand. The animals examined ranged from the higher vertebrates to the sponges, and in all cases small amounts of arsenic were found. The author concludes that this element forms a fundamental constituent of protoplasm, and points out the bearing of this fact in medico-legal cases.—Remarks on the preceding paper, by M. Armand Gautier. Arsenic is found to be specially localised in the ectodermic organs. It is not peculiar to the animal kingdom, as it has been found in certain Algæ and is probably present in sea water.—On the preparation of a pulverulent sulphur directly miscible with copper solutions, and on the simultaneous treatment of vineyards against oidium and mildew, by MM. A. and M. Campagne.—On the working and feeding of the fountain of Vaucluse, by M. E. A. Martel.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—Report on the Recent Eruption of the Soufrière in St. Vincent and of a Visit to Mont Pelée. Part I.: Dr. Tempest Anderson and Dr. J. S. Flett.—On the Correlation of the Mental and Physical Characters in Man. Part II.: Miss A. Lee, Miss M. A. Lewenz and Prof. K. Pearson, F.R.S.—Contributions to a Theory of the Capillary Electrometer. II. On an Improved Form of Instrument: G. J. Burch, F.R.S.—An Experimental Determination of the Variation of the Critical Velocity of Water with Temperature: Dr. E. G. Coker and S. B. Clement.

LINNEAN SOCIETY, at 8.—Digestion in Plants: Prof. Sydney H. Vines, F.R.S.—Relation of Histogenesis to Tissue-Morphology: A. G. Tansley.—Stelar Structure of Schizæa and other Ferns: L. A. Bondle.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Adjourned Discussion upon Captain C. C. Longridge's Paper on Oil Motor Cars of 1902.—And, *time permitting*, Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands: J. N. S. Williams.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—What is Climatic Disease: Lieut.-Col. A. M. Davies.

MONDAY, NOVEMBER 24.

INSTITUTE OF ACTUARIES, at 5.—Inaugural Address by the President, Mr. W. Hughes.

SOCIETY OF ARTS, at 8.—The Future of Coal Gas and Allied Illuminants: Prof. Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Western China: Capt. C. H. D. Ryder, R.E.

TUESDAY, NOVEMBER 25.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: Electric Tramways: C. Hopkinson, B. Hopkinson and E. Talbot.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anthropometric Investigations among the Native Troops of the Egyptian Army: Dr. C. S. Myers.—The Oldest Bronze Age Ceramic Type in Britain: Hon. J. Abercromby.

WEDNESDAY, NOVEMBER 26.

SOCIETY OF ARTS, at 8.—Le Tunnel du Simplon, et la nouvelle Ligne de Chemin de Fer Directe Anglo-Italienne pour l'Orient: Prof. Gustave Goegg.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—Experiments on the Effect of Mineral Starvation on the Parasitism of the Uredine Fungus *Puccinia dispersa* on Species of Bromus: Prof. H. M. Ward, F.R.S.—Note upon Descending Intrinsic Spinal Tracts in the Mammalian Cord: Prof. C. S. Sherrington, F.R.S., and Dr. E. E. Laslett.—The Inter-relationship of Variola and Vaccinia; with Special Reference to the Possible Derivation of Cow-pox from the Inoculated Form of Small-pox in Man: Dr. S. Monckton Copeman.—The Colour-Physiology of Higher Crustacea: F. Keeble and Dr. F. W. Gamble.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On Electrons: Sir Oliver Lodge, F.R.S.

CONTENTS.

THURSDAY, NOVEMBER 27, 1902.

MEDIÆVAL GEOGRAPHY.

The Dawn of Modern Geography. Part ii. A History of Exploration and Geographical Science from the close of the Ninth to the Middle of the Thirteenth Century (*c.* A.D. 900–1260). Pp. xix+651. By C. Raymond Beazley, M.A, F.R.G.S. (London: John Murray, 1901.) Price 18*s*.

IN the present volume of Mr. Beazley's work on the beginnings of modern geography, the author takes us from the time of the irruption of the Northmen into the Middle Sea to the days of the first western travellers in the Far East, the precursors of the Polos. He traces the gradual and painful regaining by the semi-barbarians of the early Middle Age of the earth-knowledge which their civilised forefathers had possessed, but which had been lost during the Dark Ages, until all that had once been known was known again and renascent Europe stood on the brink of discoveries of which Phœnicians, Greeks and Romans had hardly dreamed; with Marco Polo, Prince Henry the Navigator and Columbus, the third part of Mr. Beazley's work will deal.

The central fact of this period, as Mr. Beazley makes quite clear to his readers, is the Crusades. That the attack of Western Europe on the East was inspired by the spirit of the Northmen there can be little doubt. The urging of the Church would have fallen upon deaf ears had there not been abroad in the world a spirit of adventure and aggression, a will to dare and to do, which the older world had not known. This was not the spirit of Roman conquest, for it was ignorant, and had no definite consciousness of a mission to absorb and to reorganise; its desire was to do battle with the unknown, to court danger and to win renown in mortal combat with the devils and sorcerers of the East, the Paynim followers of Mahound, who was to all intents and purposes identified with the Arch-Fiend himself. If Mediæval Europe did not get this spirit of attack from the Romans, still less did she get it from their barbarian conquerors. The Ostrogoth and the Vandal, having overthrown the Empire, were suffocated and buried in its ruins. The Dark Age followed. Western Europe lay stupid, immobile, almost without an idea. Suddenly the inspiration came like a keen wind from the North; the Scandinavian descended in his multitudinous keels upon all the coasts of Europe; he conquered half England and a good part of France, he beleaguered Paris four times in forty years, he swept with the wind in his sails through the Straits and into the Middle Sea, he waged war in Sicily, and finally established himself in Miklagarth ("the great city," Constantinople) itself as the chosen *Vaering* or protector of the Byzantine Emperor. Here he held out a hand to his brethren who had imposed their rule upon the Slavs of Russia, and so the Roman world was girt about and shot through and through with the spirit of the Vikings. And by this time Roman Europe had itself influenced the Northman; it had Christianised him. He became as fierce a Christian as he had been a heathen. He gave to Christian Europe the spark of virility, the desire to dare and to do the uttermost for its faith, which it had lacked; it was now ready for the colossal adventures of the Crusades.

Mr. Beazley does not lay so much stress upon the Scandinavian origin of the Crusading spirit as we have done; with what he says, however, on p. 137, as to the general results of the Crusades we are in entire agreement. As he remarks,

"the land-travels of men who started from the Latin Kingdoms of the East" undoubtedly "led to a decisive and abiding extension of knowledge and civilisation. . . . European life was not impoverished, but enriched by the religious wars; and the only doubt must be whether it was necessary through such tribulation to enter into the brighter age of the great discoveries."

On pp. 407, 408, Mr. Beazley proceeds to exhibit one of the most striking results of the Crusades, and that one which marks a third epoch in the progress of geographical knowledge—the rise to power of the maritime republics of the Mediterranean. They supplied the necessary transport to the Crusaders, and so

"by serving the cause of Christendom they served their own; they multiplied, many times over, their carrying trade; they largely increased their export and import commerce; above all, they acquired a privileged, a more than half political, position on the coasts of the Levant. As time went on, and they became more indispensable to the Crusading princes, they were able to dictate their terms more freely, until the main burden of the Holy War rested upon them as the chief holders of power."

Thus were laid the foundations of the power of Venice and Genoa in the Nearer East, which for many centuries warded off from Western Europe the danger of Mohammedan conquest; Venice remained to the last a Crusading State, even down to the beginning of the eighteenth century, when her successful defence of Corfu under Schulemburg marked the final failure of the return-attack of the Crescent upon the Cross. From that siege dates the political decadence of Islam, and with it the political mission of the Venetian Republic also came to an end; there was no further need for her existence.

Even before the period of the Crusades, the Holy City had been the magnet which attracted hundreds of pilgrims from the West, despite the dangers of the way and the tyranny of the Saracen; the scanty accounts of their travels which have come down to us are of the greatest possible value as showing how knowledge of the Eastern Lands was gradually and painfully regained for the West; the epoch of the Crusades itself is naturally rich in such accounts of pilgrim-journeys. The impulse to far-journeying which was given by the Crusades naturally gained largely in strength in the post-Crusading period; emissaries of the republics and kingdoms of the West penetrated far into the East, and the Holy See itself did not hesitate to dispatch its representatives to the court of the Grand Cham of Tartary. These last missions were, however, hardly of the same character as those of Przhevalski or Sven Hedin; they were dictated by no desire of discovery or longing for more knowledge—for this we have to wait until the time of Prince Henry the Navigator—their aim and object was simply and solely to urge the Mongols, who were now shaking the Muhammedan power in the East to its foundations, to do the work which Christendom had been unable to do, and to destroy the common enemy of Christian and Heathen

alike. These missions, which are well described by Mr. Beazley (p. 275 *ff.*), added to geographical knowledge the outlines of a new chapter, soon to be filled up by Marco Polo.

It is noticeable that one or two of these missions, notably that of Rubruquis, were dispatched by Louis IX., King of France. Here we have the first hint of a new order of things; the domination of the Mediterranean republics in matters of commerce with, and discovery in, far-away lands was already threatened as early as the close of Mr. Beazley's period (about the middle of the thirteenth century) by the rise of the new kingdoms of Western Europe.

"As this period draws to a close," writes Mr. Beazley (p. 425), "the growth of great centralised inland kingdoms both in France and Spain was already foreshadowing a new period; when the most wealthy and unscrupulous of mercantile republics would find itself overmatched by superior resources and equal craft; and when, under the patronage of the new continental States, navies of even greater power would arise, and discoveries ruinous to Italian trade would be made in distant seas."

In fact, it was only the patronage of the Great States that made the discoveries of Prince Henry, of Columbus and of Cabot possible.

This, then, is the period of which Mr. Beazley's second volume treats; it begins with the descent of the Northmen, its central point is the Crusades, its end is marked by the impending eclipse of the trading republics by the organised power of the continental kingdoms. All else is in the nature of epilogue or addendum; the chapter on "Geographical Theory and Description" is as much an appendix as the "Appendix on Maps."

The author has known how to make his book extremely interesting; this is especially the case in the sections which deal with the deeds of the Northmen. He tells again the great story of the discovery of Vinland by Leif Ericsson of Brattahlid, of the coming of Thorfinn Karlsefne to Leif's Booths and the Long and Wonderful Beaches, of the fights with the Skraelings, of the birth of Snorre Thorfinnson, the first white American—that "finest story in the world" which should be known by heart by every Englishman, but which, we fear, is better known in Vinland itself than it is in England. He tells the tale well, and his discussion of the various theories as to the position of Vinland is very useful; he comes to the conclusion that Thorfinn's furthest south is to be placed at Mount Hope Bay in Massachusetts, in lat. 41° 24′ 10″. It is a pity that, as was of course to be expected in America, so many cranks and inexperienced 'prentice hands have busied themselves with a question which they are incompetent to solve, with the result that scientific investigation has not seldom fought as shy of Vinland as it has of Bacon-Shakespeare, anti-vivisection, or any other pseudo-scientific folly. We must, then, remember that even though the Writing Rock on the Taunton River is not a Runic inscription, but an Indian screed which "has certainly been tampered with in very modern times" (p. 75), though the Old Stone Mill at Newport is probably not more than two hundred years old and Longfellow's "Man in Armour" is a very doubtful piece of evidence, yet there is no doubt that the Norsemen reached the mainland of America and in all probability got as far south as Massachusetts, founding settlements there—shortlived indeed—as early as the closing years of the tenth century, and that the tradition of their discovery was never lost by their descendants in Europe.

The adventures of the "Jorsalafarers," of Saewulf the Englishman, of Sigurd Magnusson, King of Norway, of the monk Daniel of Kiev, and many other pilgrims to the Holy Places, are well told by Mr. Beazley; the gradual improvement in their geographical knowledge is very noticeable. Of remarkable interest are the travels of Benjamin of Tudela and his fellow-rabbi, Moses Petachia, in the Levant towards the end of the twelfth century; to them Mr. Beazley devotes a special chapter (p. 218 *ff*). To his description of the adventures of Rubruquis and other predecessors of Marco Polo in Tartary we have already alluded; in this connection we cannot but regret that he has made so very summary a reference to the very important journey of the Chinese Nestorian Rabban Bar-Ṣauma, born at Pekin, who was dispatched by the Tartar monarch Argôn in 1287 on an embassy to Constantinople, to the Pope and to the monarchs of the West in order to negotiate with them concerning an alliance for the reconquest of the Holy Land. Mr. Beazley's reference simply consists of a few lines in a footnote on p. 352, and he mentions Bar-Ṣauma merely as having been allowed by the Pope to celebrate Mass, &c. In reality his mission was very important, and the story of his journey to the West, his reception at Constantinople and at Rome, &c., as given in the Syriac "History of Mar Yahbh-Allâhâ and of Three Other Catholici and of One Priest and of Two Nestorian Laymen," is of very great interest. In the same note, Mr. Beazley spells the name of Mar Yahbh-Allâhâ "Mar Jabalaba." Presumably the second *b* is a misprint, but Mr. Beazley should have found out that the French spelling "Jabalaha" is barbarous. In the same way "Arghun" in the same note is wrong; it should be Argôn.

This brings us to the weak point in Mr. Beazley's work. He is manifestly unfamiliar at first hand with oriental sources, and he never seems to devote sufficient attention to what they can tell him about the period with which he is dealing. Thus in this volume of his book an account of Arab commercial activity and Arab contributions to geographical knowledge in the early Middle Ages is practically wanting; the subject is almost entirely relegated to a footnote on p. 462, and even there it is treated in a most summary manner. In a second edition, this note should be incorporated in the main text and considerably expanded. On p. 240, Mr. Beazley, speaking of the Assassins, says that

"the title of *Ismaelites* or *Ismaelians*, also applied to them, was derived from Ismael, seventh Imâm in the line of Ali, a descendant of whom became founder of the Fatimites."

This statement is incorrect so far as the descent of the Fatimites is concerned. Mr. Beazley should know that the Mahdi 'Obêdallâh, who founded the Fatimid dynasty, was in all probability an impostor, his descent from Ali being in the highest degree suspect.

On p. 192, the words "God most High" are in a foot-

note supposed to be translated into Arabic as "*Allah kebir*"; but this (which in any case would be ordinarily phrased "*Allah hu akbar*," "God is most great") means "God *is great*," and the phrase to which John of Würzburg is alluding is *Allah al-'âlî*, الله العلي, "God the Exalted," one of the hundred beautiful names of God. In a review of the first part of Mr. Beazley's work which appeared in these columns five years ago (vol. lv. p. 555), comment was made on the curious manner in which the author often spelt oriental, and especially Arab, names; in the present volume he seems to have taken the hint then given him, and does his best to avoid Gallic misspellings of the "Jesus Jabus" or "Doul-Karnain" type, but we still find such an unscientific transliteration as "Shaykh" (p. 239) for *shêkh*, and such a distinct mistake as "Magreb" (p. 264) for *Mâghrib*; the word is spelt with the guttural *Gh*ain, not with a *G*im. Most English writers will spell Semitic names correctly enough, but will go irretrievably wrong over a Russian or Polish appellation; Mr. Beazley, however, apparently finds Arabic or Syriac words difficult, while his spelling of Slav names is always unimpeachably correct.

In fact, when he returns to subjects with which he is thoroughly familiar, we find Mr. Beazley as valuable and as interesting as before, *e.g.* in the section of chapter vii. which deals with the geographical work of Adam of Bremen, who, as a clerk at the court of the great Archbishop Adalbert (d. 1076), was in the best possible position for gathering in the varied lore of the seafarers of the North for use in a geographical treatise. Of this lucky position he made the best possible use, and the result is that his tract "On the Position of Denmark and of Other Regions beyond Denmark" is of prime importance in the history of geography.

The appendix on maps is hardly so good as it might have been. Mr. Beazley praises the Mosaic Map of Madaba very highly (p. 580), but to us it hardly seems to merit such praise; it suffers in the first place from being executed in mosaic, and can hardly be taken to give us a very good idea of what the maps of the old Imperial period were like. On the same page Mr. Beazley says that in this map "we have one of the oldest pictures yet discovered of Jerusalem (outside the Egyptian and Assyrian monuments)." This passage has puzzled us considerably, for there is no representation of Jerusalem upon any Egyptian monument whatever, not even one of the time of Sheshenk I. (Shishak), and the Assyrian bas-relief of a town with a name ending in . . . *alammu*, which exists in the British Museum, cannot be identified with Jerusalem with any confidence. Perhaps Mr. Beazley is thinking of the reliefs representing Sennacherib's siege of *Lachish*. In his next edition the misleading phrase between brackets should be deleted. Mr. Beazley does not give many references to modern experts in antique cartography; as in the former volume, no mention is made of the name of the late Mr. Coote, for example. In the review of the first volume it was stated that "the revision of the whole of chapter vi. [of vol. i.], on 'Geographical Theory,' together with Mr. Beazley's account of the history and use of mediæval maps for the whole book—although Mr. Beazley omits to state the fact—is due, we understand, to Mr. C. H. Coote, of the Map Department of the British Museum."

Mr. Beazley seems to have odd ideas as to the function of a footnote; he often uses it to convey some little piece of further information which could perfectly well have been inserted in the main text, *e.g.* on p. 130 we read that of the Crusade of Siegfried Archbishop of Mainz, out of "seven thousand only two[1] returned"; on referring to note[1] we find the laconic addition "thousand." There are other instances in the book of the same peculiarity.

Finally, we must, as before, protest against the insufficient indices with which Mr. Beazley provides his successive volumes. No doubt he will give us a proper index to the whole work when it is completed, but meanwhile we have nothing but a "short index of names," which is of little use. It would have been a better plan to have provided a full index for each volume.

Generally speaking, then, the chief fault we have to find with Mr. Beazley is his manifest unfamiliarity with Eastern matters, which sometimes causes him to make serious mistakes when dealing with the oriental side of his subject. For all else he is excellent, and, moreover, he has written a most interesting book.

SOIL AND SANITATION.

The Earth in Relation to the Preservation and Destruction of Contagia, being the Milroy Lectures delivered at the Royal College of Physicians in 1899, *together with other Papers on Sanitation.* By George Vivian Poore, M.D. (Lond.), F.R.C.P. Pp. 257. (London: Longmans, Green and Co., 1902.)

THIS book is the work of an enthusiast, but to find fault with enthusiasm in these days of rapid progress and fresh discoveries would be unwise. Mr. Rider Haggard, with his watchword "Back to the Land," and Sir Seymour Haden, with his advocacy of "superficial and coffinless burial," are both enthusiasts. Who will venture to say that Mr. Rider Haggard or Sir Seymour Haden or Dr. Vivian Poore are idle dreamers? None dare say this, and if in some directions the writer of this review ventures to dissent from Dr. Poore's conclusions, it must be understood that he does so in a spirit of tolerant sympathy with the author's main contentions.

In the first six chapters, the distinguished author seeks to show that such diseases as tetanus, anthrax, diarrhœa, dysentery, cholera, Malta fever, malaria and enteric fever have not been proved to be "soil diseases" in the proper sense of the term. That is, that the prominent part assigned to soil in the spread of disease among human beings is largely speculative in character. At the same time, the author freely admits that contaminated soil may occasionally (accidentally, as it were) be the means of causing isolated attacks or even localised outbreaks of certain diseases. Nevertheless, he refuses to regard the soil as a "breeding ground" for pathogenic microbes or as capable of exerting any sustained power of spreading disease. On the contrary, he considers the soil effective in bringing about the dissolution of harmful germs.

Chapter vii. deals with the Maidstone epidemic, and is an intelligent, but not wholly unbiassed, criticism of the

conclusions arrived at by the experts engaged in the inquiry. The author says :—

"The epidemic is remarkable, not only for its severity, but from the fact that six gentlemen, all eminent for their skill in bacteriology, failed to discover a single typhoid bacillus."

The failure to isolate the typhoid bacillus was in no way remarkable ; it is a matter of real difficulty to discover its presence in a typhoid stool. At Maidstone, the pollution of the implicated water with microbes of excremental origin was abundantly proved, and no bacteriologist of repute would consider that failure to isolate *B. typhosus* from an implicated water afforded any proof whatever that this microbe was in reality absent.

Chapters viii., ix. and x., dealing respectively with immunity, practical considerations and agriculture, contain many thoughtful passages. But the author, in the pursuit of his main thesis, which may briefly be described as a plea for the methodical deposition of fæces on well-tilled humus, advocates measures which, as regards water supply, are open to some objection. But few will find fault with expressions of opinion such as the following :—

"Apart from the question of food-supply, it is, I believe, absolutely necessary to encourage agriculture in order that our race may be maintained in vigour."

"Anything which discourages or increases the difficulties of agriculturists can hardly be in the interests of the public health."

Chapter xi., on the maintenance of the fertility of the soil, is of considerable interest. The author quotes Sir William Crookes's famous address to the British Association (1898), a fragment of which may here be cited :—

"In the United Kingdom we are content to hurry down our drains and watercourses into the sea fixed nitrogen to the amount of no less than 16,000,000*l.* per annum."

True ; but in how many million pounds of adventitious material is this store of potential wealth concealed? Moreover, it may be good economy to allow to run to waste a potentially valuable substance if its retention (assuming questions of practicability and commercial gain) involves serious risk of danger to human beings.

In chapter xii., Dr. Poore interests the reader with an instructive account of sanitation in Holland.

Practical sanitarians would do well to read chapter xiii., describing the experiments conducted under the auspices of the city of Manchester as regards the disposal of refuse on Carrington Moss. The case may be an exceptional one, but the figures given by Dr. Poore are most instructive.

Dr. Poore's conclusions are given in chapter xiv., which contains also an interesting account of the author's experiments at Andover, in which the ordure and refuse of about 100 persons have been applied for fourteen years to rather more than one acre of land with conspicuous success as regards the amount of produce extracted from the soil. The author, by implication if not by direct statement, appears to consider that what is, under the superintendence of a master spirit, possible and practicable in the country must of necessity apply also to the complex conditions attending the disposal of excremental matters in the neighbourhood of large towns. The remark that

"the nineteenth century closed with the spectacle of a Royal Commission still discussing the best way of *destroying* the potentialities of life and prosperity"

might well have been omitted ; and it is to be regretted that the writer throughout his book so often seems to view a grave and serious problem through the wrong end of the telescope. But opinions such as the following will excite the sympathy of many readers :—

"At present he who advocates any attempt to entice a fair proportion of the people 'back to the land' is regarded as a Utopian dreamer. I feel convinced that the only chance of getting a living from agriculture lies in the due enrichment of the soil."

Chapters xv. to xviii. deal with an address to the Royal Medical and Chirurgical Society on enteric fever, and in chapters xix. to xxii. various papers on sanitary matters by the author are considered. They contain much useful and original information, and will repay careful perusal.

In conclusion, it may be said that the book is a noteworthy one. It is the work of a distinguished physician, an original thinker, and a lucid and polished writer. It is not free from defects, some dogmatic statements and one-sided opinions ; and the author's sanitary teachings do not always seem to the writer of this review to be of a wholly sound character. But a colourless reproduction of orthodox doctrines and the opinions of other men makes dull reading ; and no one who studies the book will regret having done so, nor will he fail to find in its pages many new and original thoughts, and fresh ways of interpreting old facts. That the book will add to the high reputation already enjoyed by Dr. Poore is certain.

A. C. HOUSTON.

STEEL-WORKS ANALYSIS.

The Analysis of Steel-Works Materials. By Harry Brearley and Fred Ibbotson. With Illustrations. Pp. xv + 501. Price 14*s.* net. (London, New York and Bombay : Longmans, Green and Co., 1902.)

ANALYSIS in the laboratories attached to works necessarily differs widely from the analysis of schools or that of research. To compare them is to compare the work of professionals with that of amateurs. The works chemist is already familiar with the methods he has to use, as well as with the general principles on which they are based, before he begins his daily round of endless determinations. Consequently, the best book for him will, in general, be shorn of philosophic considerations, of lengthy descriptions of ordinary manipulations, and of accounts of obsolete processes, though they may be of great educational value and historical interest. He needs a terse, accurate description of processes that he can use, with references to the difficulties that may be encountered and to the limitations that cannot be avoided. He must be able to find out quickly all that he wants to know, and he must not be misled. It is difficult to imagine a book which would be equally suitable for schools and works, but most treatises on analysis are compromises. The book now under review, which, by the way, is the second

on the subject that has emanated from Sheffield, is no exception to the rule, though certainly better adapted for steel-works chemists than for students.

The book is divided into thirteen parts—the first four, containing 185 pages, being devoted to the chemical analysis of iron and steel and their alloys; and the succeeding five, comprising 45 pages, to the analysis of refractory materials, slags, fuel, boiler water and scales. These are of the greatest value. In the preliminary summaries placed at the beginning of each section, a general view of the various methods is given which will be found extremely useful in aiding the chemist to decide on his course of action in any particular case. The methods are described carefully and in sufficient detail, without needless repetition and with a freedom from error which cannot be too highly praised. Especially interesting are the pages devoted to rapid analysis at the furnace. Cases arise, for example, in the preparation of armour plates when the percentage of a number of elements must be determined while the charge of fused metal is still in the furnace. It will be a matter for surprise to many analysts that an expert operator was found to occupy only eight and a quarter minutes in the estimation of manganese, and that twelve minutes is considered enough for the estimation of silicon.

Part x., dealing with the analysis of the alloys of copper and the "white metals," is little less satisfactory than the preceding parts, but the remaining sections show a distinct falling-off from the high standard reached in the earlier pages. The micrographic analysis of steel is not well described. The lack of detail and some misleading statements prevent the article from being of use to a beginner, and an experienced worker will find nothing here to help him, except in the bibliography, which, unfortunately, stops short in the beginning of the year 1898! The illustrations are poor, perhaps owing to the fact that most of them are not photographs, but merely hand sketches, and the absence of reproductions of the structures to be observed under high magnifying powers is noticeable. The weakest part of the book, however, is the meagre and unpractical account given of pyrometry, which is not written by either Mr. Brearley or Mr. Ibbotson. Only the Le Chatelier thermocouple is described, and the modern forms of pyrometers in which it is used, as well as other types of instrument, are either ignored or barely mentioned. A clumsy and inconvenient method of recording the indications of the thermocouple is described, a method which was devised some years ago and abandoned everywhere, unless it is still in use in Sheffield, within a few months of its introduction. In future editions, this section should be either omitted or revised and extended.

At the end, there is a valuable bibliography of papers on steel-works analysis, which occupies 139 pages and seems to be fairly exhaustive. It is compiled by Mr. Brearley, and includes papers which appeared up to the end of 1901.

The book, in spite of its uneven merit, can be confidently recommended. The publishers have done their part of the work well in all respects. The authors write readable English, with a touch of the vigour on which Sheffield prides itself, manifested, for example, in a certain contempt for what they are pleased to call "hoary assertions."

LECTURES ON CELESTIAL MECHANICS.

Die Mechanik des Himmels. Vorlesungen von Carl Ludwig Charlier, o. Professor an der Universität Lund. Erster Band. Pp. viii + 488; mit zahlreichen Figuren. (Leipzig: Veit and Co., 1902.) Price Mk. 18.

THE number of text-books on the subject of celestial mechanics is by no means so large but that an addition ought to be warmly welcomed. More especially is this the case when the author is one who has himself made many valuable contributions to this difficult branch of analysis. Prof. Charlier's original work is characterised by great clearness and, as far as possible, simplicity. These qualities are not wanting in the lectures which he has delivered in the University of Lund since the autumn of 1898, and of which a first volume is now published. One cause for some regret may perhaps be mentioned. Prof. Charlier has shown, in several papers which he has recently published, that he can write excellent English. It is a pity, from our point of view, that in the case of his lectures he has preferred to publish in German, for there does not exist in our language a work of the same scope. Let it be said, however, that the German is exceptionally simple and should cause little difficulty to a reader whose knowledge of the language is slight.

The scheme of the lectures is to give a simple exposition of the present position of researches in celestial mechanics, so far as the motions studied do not depend on the dimensions and figures of the celestial bodies. In the selection of his subject-matter, the author's aim has been two-fold, namely, to lay stress on the results of the greatest astronomical importance and to illustrate the clearness and elegance characteristic of modern methods of analysis. The numerical examples which have been introduced for the sake of the former object might, perhaps, have been augmented with advantage. Prof. Charlier freely acknowledges the incompleteness of his work, and finds an explanation in the transition period in which astronomy stands and in which it is difficult to distinguish what is essential from what is unessential. The excuse is unnecessary, for it would be unfair to expect a systematic treatise in what does not pretend to be more than a course of lectures. And as such the book will be found interesting and suggestive, because it forms an introduction to recent developments of theory which have in many cases been accessible only in the original memoirs themselves.

The scope of the work will be best understood by a brief glace at its contents. This first volume contains the results of a more general character in the problems of two and three bodies. It is divided into seven sections. The first section contains preliminary theorems in pure mathematics and mechanics which would probably be familiar to the class of English reader who would attempt to use the book. At least, this is so in the case of paragraphs dealing, for instance, with the theory of determinants, the properties of functional determinants, linear substitution and Lagrange's equations. Yet it is useful to have such theorems actually at hand for reference, especially in a book which is genuinely

elementary in the sense that no excessive demands are made on the reader's knowledge at the outset. Here is introduced the canonical form of equations which is destined to play a predominant part in the sequel, and earlier is a sketch of the theory of linear differential equations with periodic coefficients as developed by Hermite, Floquet and Poincaré.

In the second section, the partial differential equation of Jacobi is discussed and Stäckel's important theorem on the possibility of solving it by separating the variables is given. This leads to the consideration of motions determined by one degree of freedom, and in particular of forms of motion termed "Libration" and "Limitation," the latter being of the nature of Poincaré's asymptotic solutions. An account follows of conditionally periodic motions, based on the researches of Staude.

The third section treats of the motion of a particle attracted by two fixed Newtonian centres of force. This problem provides illustrations of the theory of the previous section. Otherwise it is a little inconsistent with the practical aim of the author, for its astronomical interest, as was frankly admitted by Lagrange, is very slight. A reference might here have been made to Prof. Greenhill's paper on the stability of such forms of motion (*Proc.* Lond. Math. Soc., vol. xxii.).

The problem of two bodies is treated in some detail in the fourth section, the Hamilton-Jacobi equation being made the basis of the discussion. The case of a repulsive force is also discussed, and this leads to a digression on the dynamical theory of the tails of comets.

The most important results in the general problem of three bodies are investigated in the fifth section. The general integrals and the different forms which they assume when expressed in different systems of coordinates are discussed. The method of variation of parameters is explained in conjunction with Jacobi's canonical elements and also in connection with relative coordinates. The chief results of Jacobi's classical memoir on the elimination of the nodes and of Laplace's theory of stability are given here. Finally, the equations of the problem are reduced to the form expressing four degrees of freedom.

The rest of the book is devoted to the theory of perturbations. In the sixth section, Poincaré's system of canonical elements is introduced, the form of the development of the disturbing function is described and a very brief sketch of Laplace's coefficients is given. The final section contains the theory of secular perturbations of a planetary system, which is treated in some detail. At the end of the volume will be found some useful numerical tables.

The second volume is promised for next year. It will contain the theory of periodic orbits in the problem of three bodies and researches on the convergence of series.

H. C. P.

OUR BOOK SHELF.

Lexikon der Kohlenstoff-Verbindungen. By M. M. Richter. Pp. 2482. (Hamburg: Leopold Voss, 1899.) Price, 39 parts, 1.80 marks each.

NOTHING could illustrate more forcibly the rapid growth of organic chemistry than the increased dimensions of the new edition of Richter's "Tabellen der Kohlenstoff-Verbindungen," published in 1884, which now appears for the first time under the title of "Lexicon."

The first edition, the publisher tells us, accounted for 16,000 compounds; in the present volume, which is brought down to the first quarter of 1899, 67,000 compounds are described, so that in fifteen years organic chemistry may be said to have multiplied more than fourfold. It is not surprising to learn that the stupendous labour of collecting and arranging this enormous mass of material has taken ten years to complete.

The lexicon contains all the known carbon compounds, arranged in order of their molecular formulæ on an ingenious system, which is fully set forth in the introduction. The name and a few physical constants are given, but the chief information is contained in the very full references to the original literature and to Beilstein's well-known "Handbuch." Since the first edition of the book appeared, the nomenclature of the Geneva Commission has been introduced, and in many cases the new and the old names appear side by side.

There is also an index of the names of the different compounds at the end of the volume.

Where organic research is being pursued with the almost feverish rapidity which is in vogue, more especially in the German laboratories, involving in the process the production of many compounds, both old and new, it is easy to understand the time and trouble which might be expended in fixing the identity of these compounds. One object of the lexicon is to lighten the labours of the investigator in this direction.

This becomes more imperative where the number of isomerides is large, for it is not uncommon to meet with 50, 60, or even 100 substances with the same molecular formula. For example, an experimenter who happened in the course of his research to obtain a compound of the formula $C_7H_{10}O_4$ would be confronted with a choice of 59 substances among compounds already known. By reference to the lexicon, he would see from the physical properties whether the compound had already been prepared, or, failing this, he could at once refer to the literature on the subject.

Richter's "Tabellen" is sufficiently well known among chemists and its utility long enough proved to ensure an excellent reception for the new edition and to render superfluous any further description of its use or its merits.

The author complains (and who does not) of the present system, or lack of system, of chemical nomenclature.

Organic chemistry has, in fact, outgrown its mother-tongue. It can no longer express itself clearly in the language of its childhood. An attempt was made by the Geneva Commission of 1892 to introduce reforms, and some excellent proposals were made, and have since been to some extent adopted on the continent. The author adds, "it is and remains deplorable, the fact that the resolutions arrived at at Geneva have no prospect of being generally adopted." It is to be hoped that before many more thousands have been added to the still growing number of organic compounds, the confusion which is rapidly impending through the want of a universally recognised system of nomenclature will be averted by a complete and thorough revision, more especially of the names of ring compounds.

J. B. C.

Ueber Harmonie und Complication. By Dr. Victor Goldschmidt. Pp. 136; with 28 figures. (Berlin: Julius Springer, 1901.) Price 4 marks.

MANY attempts have been made to associate the forms occurring in music with forms which manifest themselves to senses other than that of hearing. If the term "harmony" is used to include all such groupings and arrangements as give us pleasure, then we have harmonies

of form, harmonies of colour, and so forth. Dr. Goldschmidt's object appears to us to be to reduce all such harmonies to a common formula, and he considers that the different kinds of harmony are governed by a common law, the "law of complication."

As an example of the arguments employed, a series of numbers is obtained from the intervals of the musical scale which coincide with numbers in another series alleged to be obtainable from crystallography. But the numbers in the case of the music do not represent actual intervals, but are derived from them by a homographic transformation, according to which the keynote and its octave are represented by 0 and ∞ and the major fifth by 1, and the series is incomplete unless the minor seventh be included in the list. And the identity of the two series is by no means complete; for there are terms in the series derived from music which are absent from that obtained from crystallography.

It is easy to find connections as close as those dealt with in the present work between phenomena which have nothing whatever in common. For a considerable period, the number of wranglers in the Cambridge mathematical tripos was observed to be intimately related to the frequency of sun-spots, and anyone who should seek to establish a connection between the notes of the musical scale and the courses of a *table d'hôte* dinner might easily make out a very strong case. What is most surprising is that the analogy which *a priori* exists between musical intervals and colour intervals, both of which depend on ratios of vibration-frequency, appeals but little to our senses, so little, in fact, that certain writers have even sought to establish relations between chords and colours quite independently of the known relations of pitch. As for the connection which no doubt exists between a love of music and a talent for mathematics, its cause is not difficult to find. A mind like that of Beltrami, who could discover in the purely abstract ideas of geometry and algebra truths applicable to spaces other than that in which we live, was necessarily well trained to appreciate that beauty of form dissociated from worldly matters which exists in the sonatas and symphonies of the older composers. In order, on the other hand, to make it more palatable to a mind that wants to grasp something tangible, music is commonly associated with such mundane ideas as love, vice, battle and murder, and sudden death, the triumph of the victorious. the wails of the vanquished.

Opere Matematiche di Francesco Brioschi. Vol. ii. *Opere Matematiche di Eugenio Beltrami.* Vol. i. Pp. 456 and 437. (Milan: Ulrico Hoepli, 1902.) Price 25 lire.

THE second volume of Brioschi's works contains thirty-five papers contributed to the *Annali di Matematica pura ed applicata*, series 1 and series 2, vols. i.–xiv., between the years 1858 and 1887. These papers have all been carefully revised by Profs. Cerruti (Rome), Gerbaldi (Palermo), Loria (Genoa), Pascal (Pavia), Pittarelli (Rome), Reina (Rome) and Tonelli (Rome). A considerable number of them deal with linear differential equations, but elliptic and hyperelliptic functions, curvilinear coordinates, binary forms and many other subjects are treated; and the papers also include obituary notices of Borehardt and Chasles.

After the death of Prof. Beltrami, in 1900, the Faculty of Science of the University of Rome resolved to establish a memorial of the distinguished mathematician, and it was decided that the most fitting form for the memorial would be a complete edition of Beltrami's collected works; to quote Prof. Tonelli, *monumentum aere perennius.* In this case, the work of preparing the volumes has been carried out entirely under the direction of Profs. Cremona, Castelnuovo and Tonelli, as representatives of the Roman Faculty of Science, who have been aided by the collaboration of Profs. Bianchi, Burgatti, Cerruti, Dini, Pittarelli, Reina and Volterra. The order of arrangement differs from that adopted for Brioschi's works. Instead of being grouped according to journals, Beltrami's papers are arranged in strict chronological order, and this volume represents the work of eight years, from 1861 to 1868. That these first eight years of Beltrami's career as a mathematician were productive of work of great value is shown by the list of titles, which include researches on analysis applied to geometry, the flexure of ruled surfaces, resolution of the problem of transforming geodesics on a surface into straight lines in a plane, complex variables on any surface, fundamental theories of space of constant curvature, and last, but not least, the "Saggio d'interpretazione" of non-Euclidean geometry. The portrait of Beltrami which forms the frontispiece is due to Prof. Pittarelli.

Beltrami's works are published in uniform style with those of Brioschi, and both are printed by the Mathematical Press, of Palermo.

Handbook of the Trees of New England. By L. L. Dame and Henry Brooks. Pp. xv + 196. (Boston, U.S.A.: Ginn and Co., 1902.)

THE interest connected with the flora of the New England States lies in the fact that situated between Canada and the Alleghany Mountains they furnish the meeting point of a northern and a more southern flora. Since the book is limited to such a relatively small part of the country, it does not possess the general interest which would attach to one which included, for instance, the trees of all the eastern States. What it loses in comparative value, perhaps it gains in definiteness; it contains useful and succinct descriptions, good illustrations specially drawn, and states the horticultural value of all the indigenous species. The Latin nomenclature is satisfactory and correct, except in the case of a species of Acer, and for *Quercus Muhlenbergii*, which is considered by some authorities to be a variety of *Quercus prinus*; but the popular names are in utter confusion, and we cannot agree with the authors that it is wiser "to record what is, and not what ought to be." Taking *Populus balsamifera* as an illustration, the names recorded are "Balsam. Poplar. Balm of Gilead." Now this tree is certainly not a balsam, and *Populus candicans* is the real Balm of Gilead; while the name balsam-poplar would be sensible and correct. Apart from this and within its limits, the book may be recommended either to enable one to identify the trees or to ascertain their characteristics. English readers will find that only about half-a-dozen species are the same as those indigenous to this country.

Lake-Country Rambles. By William T. Palmer. Pp. viii + 334. (London: Chatto and Windus, 1902.) Price 6*s*.

MR. PALMER has here collected a series of papers he has from time to time contributed to various magazines. For many years the author has been a rambler in the lake-country, and has learned to love its inhabitants and to study its varied scenes. The essays are good examples of descriptive writing, but the aspects of nature and the incidents of outdoor life are treated rather from the point of view of the general observer than that of the inquiring naturalist.

Junior Arithmetic Examination Papers. Arranged by W. S. Beard. Pp. vi + 106. (London: Methuen and Co., 1902.) Price 1*s*.

THE ninety examination papers contained in this collection cover all the parts of arithmetic generally studied in schools. The first third of the papers gradually increase in difficulty from paper 1, on the first four rules, to paper 30, on the mensuration of rectangular solids. The remaining papers are made up of mixed questions and are all well graduated. The questions should be useful to teachers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Classification of Quartic Curves.

THE best method of classifying curves is to commence with one which is founded on properties which are unaltered by projection. We thus obtain ten principal species of quartic curves, viz. *anautotomic, uninodal, unicuspidal, binodal, nodocuspidal, bicuspidal, trinodal, binodocuspidal, nodobicuspidal* and *tricuspidal*; but each of these species admits of a variety of subsidiary divisions, owing to the fact that all curves of a higher degree than the third may possess compound singularities.

Anautotomic, unicuspidal, bicuspidal and tricuspidal quartics admit of a subsidiary division depending on the number of points of undulation they possess; and it must be borne in mind that, although it is convenient to use the term point of undulation, it is the tangent at this point and not the point itself which is the actual singularity.

Uninodal quartics admit of *three* primary subdivisions, according as the double point is an ordinary node, a flecnode or a biflecnode.

Binodal quartics admit of *seven* primary subdivisions, six of which depend on the character of the node, whilst the seventh arises from the fact that the two nodes may unite into a tacnode.

Nodocuspidal quartics admit of only *four* primary subdivisions, three of which depend on the character of the node, whilst the fourth arises from the fact that the node and cusp may unite into a rhamphoid cusp.

Trinodal quartics admit of *ten* primary subdivisions, and in order to particularise them, we shall denote the different singularities which involve a double point by their initial letters, except that *tp* and *tc* will be used to denote a triple point and a tacnode cusp respectively; so that the nomenclature n, n, n and n, n, f will indicate that the quartic has three nodes or two nodes and a flecnode respectively. We shall then have the following ten species:—(1) n, n, n; (2) n, n, f; (3) n, n, b; (4) n, f, f; (5) b, b, b; (6) t, n; (7) t, f; (8) t, b; (9) o: (10) *tp* of the first kind.

Binodocuspidal quartics admit of *eight* primary subdivisions, which are as follows:—(1) c, n, n: (2) c, n, f; (3) c, f, f: (4) t, c; (5) r, n; (6) r, f; (7) *tc*; (8) *tp* of the second kind.

Nodobicuspidal quartics admit of *three* primary subdivisions, which are:—(1) c, c, n; (2) c, r; (3) *tp* of the third kind.

Whenever any of these primary species represents a curve which has two or more points of inflection, a further subdivision may usually be made which depends upon the number of points of undulation it can possess. Thus the species n, n, n may possess two, one or no points of undulation; whilst the species c, c, n may possess one or no such points.

A fourth subdivision may sometimes be made which depends upon whether the quartic is capable of being projected into a curve which is symmetrical or hemisymmetrical with respect to a pair of rectangular axes. In some cases, the possibility of the projection involves the existence of compound singularities, and thus the curve belongs to one of the species already considered; but in other cases, the necessary conditions do not affect the singularities. Thus all trinodal quartics which are capable of projection into symmetrical curves must belong to the species n, n, b; b, b, b; or t, b, in which three respective cases the quartic can be projected into the inverse of an ellipse or hyperbola with respect to its centre, the lemniscate of Bernoulli or the lemniscate of Gerono. On the other hand, the possibility of projecting any quartic with three double points into a hemisymmetrical curve depends upon whether it can be projected into the inverse of a conic with respect to a point in its axis. The conditions for this do not necessarily involve compound singularities, since these will only exist for special positions of the centre of inversion.

There is no necessity to adopt a classification founded on the nature of the branches at infinity, since all the results can be obtained by projection. Thus, if a straight line cutting in four real points any quartic, which is unipartite and perigraphic, be projected to infinity, the projection will be quadripartite and will have four real asymptotes; and by taking special positions for the line to be projected, a variety of special results can be obtained. By projecting a triple point or a pair of crunodes to infinity, it is at once seen that a quartic can have three parallel or two pairs of parallel asymptotes. Also, if the polar cubic of a point o breaks up in to a conic and a line cutting the quartic in four ordinary points and the line be projected to infinity, the projection will have four asymptotes meeting in a point.

A quartic having three acnodes is the limiting form of an anautotomic quartic in which the acnodes are replaced by three perigraphic curves; and if a line cutting the fourth portion in four real points be projected to infinity, the projection will be septipartite. From this it appears that the partivity of a curve of the nth degree cannot be less than $n+\frac{1}{2}(n-1)(n-2)$.

A. B. BASSET.

Fledborough Hall, Holyport, Berks, November 14.

The Conservation of Mass.

APROPOS of the recent discussion on the conservation of mass at the Belfast meeting of the British Association, the following calculation may be of interest; it relates to the loss of weight undergone by a body when raised vertically.

If g is the acceleration of gravity at a specified point on the surface of the Earth, m the mass of a body of weight w, then

$$w=mg.$$

Now let the centre of gravity of the body be raised through a vertical distance d; g will be changed into

$$g'=\left(\frac{\mathrm{R}}{\mathrm{R}+d}\right)^2 g,$$

R being the radius of the Earth (supposed spherical), and the corresponding weight of the body will be

$$w'=mg'$$

on the supposition of the conservation of mass.

The loss of weight is thus

$$\delta=w-w'=w\left\{1-\frac{\mathrm{R}^2}{(\mathrm{R}+d)^2}\right\}$$

$$=w\left\{1-\left(1+\frac{d}{\mathrm{R}}\right)^{-2}\right\}=\frac{2dw}{\mathrm{R}},$$

neglecting second and higher powers of $\frac{d}{\mathrm{R}}$.

As a particular example, take $w=1$ kilogm., $d=10$ cm. and R approx. $=6357\times10^5$ cm.

Then

$$\delta=0{\cdot}00003 \text{ gm.}$$

[The term involving $\left(\frac{d}{\mathrm{R}}\right)^2$ would have the first significant figure in the fifteenth place, and therefore we were justified in this case in neglecting it.]

This small difference is, I believe, of the same order as those which Prof. Landolt found; but the ratio of the difference to the whole weight (*i.e.* $2d:\mathrm{R}$) must have been much greater in his experiments. Although Prof. Landolt's discrepancies may receive a perfectly different explanation, it is quite conceivable that a balance could be constructed which would detect such small differences. It is scarcely necessary to point out that, in the actual performance of the experiment, the scale-pan containing the counterpoising weights must be at the same height during the two weighings.

D. M. Y. SOMMERVILLE.

St. Andrews, November 12.

A Simple Experiment in Diffraction.

M. G. FOUSSERAU describes, in the *Journal de Physique* for October, a simple apparatus for viewing diffraction and interference phenomena, a modified form of which I have experimented on with success. In the latter form, the source of light was obtained by placing a diaphragm on the stage of a microscope, on which sunlight was concentrated by means of the mirror and condenser, and the diffraction effects were produced by placing perforated pieces of tinfoil on the top of the microscope tube where the eye-piece is usually placed. On placing the eye close up to the tiny hole in the tinfoil, various diffraction patterns were seen. The difficulty of piercing a hole that is truly circular in tinfoil made it hard to obtain perfect rings, but the "failures" were often very interesting. A rectangular aperture

was easily got by cutting slits in two pieces of tinfoil with a razor and placing one over the other with the slits at right-angles, while for a triangular aperture three strips of tinfoil placed so as to leave just a tiny triangle open gave good results.

G. H. BRYAN.

The Secular Bending of Marble.

THE fluidity of marble under pressure, of which Dr. See mentions an instance in NATURE (p. 56), has, I believe, been well established by laboratory experiments. Another instance of secular bending, similar to that quoted by Dr. See, was to be seen in two alabaster slabs which formed the jambs of a doorway in the Alhambra. Owing to the pressure brought to bear on these by the settlement of the building, they had bulged out from the wall by as much (if I remember right) as 6 or 7 inches. The slabs were about 7 feet long and a foot wide, their thickness being, perhaps, a couple of inches. Whether they are to be seen there still, or not, I do not know.

SPENCER PICKERING.

Summer and Winter.

CONCERNING the relation of summer and the following winter referred to on p. 63, a few facts from Greenwich records of the last sixty-one years may be acceptable. We find this:—

Summer warm,	winter severe,	9	cases.
,, ,,	,, mild,	19	,,
,, cold	,, severe,	17	,,
,, ,,	,, mild,	12	,,

(This leaves four cases with average values.)

It thus appears that warm summers have been distinctly more often followed by mild winters than by severe ones; but the difference in the other case, of cold summers, is less pronounced. In this representation, wet is left out of account, the mean temperatures of summer and winter being alone considered, and in relation to the averages. But we might limit our attention to summers that have been both cold and wet, as this last summer has been. (Cold summers have not always an excess of rain.) Of such there appears to have been nineteen. Now taking all those with a mean temperature under 60°·5 (the average mean temperature of summer below 61°·2), I find that nine were followed by severe winters and only three by mild winters; total, twelve. As the past summer comes in this group, the chances seem in favour of a severe winter.

A. B. M.

Personal.

I DID not think it worth while to correct an error into which the reporters of the ephemeral Press fell in prefixing the words "his own" to the word "work" in the account of my recent speech at Liverpool, where I had said that my new sphere afforded me a larger opportunity for work: simply.

I do not know how best to correct it, or whether it is now possible, but I see it has been reproduced in your University Intelligence on p. 70, and an error incorporated in NATURE is of rather permanent character, and may be misleading to my friends.

OLIVER LODGE.

Birmingham, November 21.

MATHEMATICS IN THE CAMBRIDGE LOCALS.

ON May 29 (vol. lxvi. p. 117), we announced an important change in the geometry of the *Oxford* local examinations for 1903. Quoting from the notice which had just been issued, attention was directed to the important statement that "Questions will be set so as to bring out as far as possible a knowledge of the principles of geometry, a smaller proportion than heretofore consisting of propositions as enunciated in Euclid. Any solution which shows an accurate method of geometrical reasoning will be accepted. No question will be set involving necessarily the use of angles greater than two right angles. Geometrical proofs of the theorems in Book ii. will not be insisted upon." We have now received the schedules in geometry that have been adopted for the *Cambridge* preliminary and junior local examinations in 1903. In these, we are glad to see that the Cambridge Syndicate has adopted to an even greater extent the reforms suggested by the recent British Association Committee. For the preliminary, junior and senior examinations:—"Any proof of a proposition will be accepted which appears to the examiners to form part of a logical order of treatment of the subject. In the proof of theorems and deductions from them, the use of hypothetical constructions is permitted." No schedule will be published for the senior examination. The importance of the schedules now published for the preliminary and junior examinations will be apparent when it is considered that they may be said to cover the work done by the boys and girls in all secondary schools up to the age of sixteen years, and the work of such older boys and girls as are not trying for marks of distinction. Their influence is great, and we heartily welcome the important change that they place much greater stress upon observation, measurement and experiment than on abstract reasoning. It is to be observed also that there is no mere pretence of accuracy:—"Every candidate must be provided with a ruler graduated in inches and tenths of an inch, and in centimetres and millimetres, a small set square, a protractor, compasses furnished with a hard pencil point, and a hard pencil." This mention of the hard pencil is business-like; as soon as boys understand that in their measurements of lines they must not make errors of even one-hundredth of an inch, their true scientific education begins. As for demonstrative geometry, a great number of Euclid's propositions are left out altogether. Books ii. and iv. have completely disappeared. Twenty-eight out of the forty-nine propositions of Book i. have to be studied for the preliminary and junior. Of the thirty-seven propositions of Book iii., only ten have to be studied for the preliminary and four more for the junior. Of the thirty-five propositions of Book vi., only thirteen are required for the junior. The most important part of the geometry examination is called practical geometry, and there is every inducement to all teachers now to dwell largely on experimental geometry, as all good teachers have done for many years.

We have reason to believe that in dealing with arithmetic, algebra and trigonometry, the syndicate will follow, as closely as it has done in geometry, the recommendations of the British Association Committee as drawn up by Prof. Forsyth. Should this be so, we are assured of a very great reform in the teaching of mathematics in all the secondary schools of England. This consummation will be further assured by recognition of the reform, which will surely come soon, on the part of the Civil Service Commissioners and all other examining bodies in the kingdom. We may say, then, that every average boy looking forward to a career in the Civil Service, in the Navy, in the Army, in any of the professions, will have had an incubus lifted from his life, and a much greater load will have been lifted from the spirits of his father and mother. Boys susceptible of being crammed for examinations will no longer have an unfair advantage over their far wiser and more sensible but reputedly stupid fellow competitors. There will, moreover, be a chance that boys from schools will be able to take better and fuller advantage of the instruction given in technical colleges.

To the educationist, the reform, however far-reaching in its results, may appear small; he may think that it should have been effected long ago. This view, however, does not in our opinion do justice to the services of the reformers. It leaves out of account the strength of the opposition. This reform needed that many men should work in an unhopeful, heart-breaking way for it for many years, and its importance is not diminished by its coming

at last quite suddenly, and as if miraculously, like the fall of the walls of Jericho.

In criticism of the schedules, we may perhaps be allowed to say that personally we wish the syndicate had not followed Euclid so closely. All the practical geometry of the syllabus is mere illustration of Euclid. There are, for example, other angles than 90° easily to be drawn; arithmetical computation and experimental mensuration give new avenues to geometrical ideas, and the more avenues we can offer to pupils the better. Where the syllabus says "division of straight lines into a given number of equal parts," there appears to us too much restraint. There is no reason why a line should not be divided into many parts in any proportions, and a most educational exercise it would be. And what is the use of hiding the fact that a "preliminary" candidate cannot be prevented from having a good working knowledge of Book vi., although it is wise enough to keep the demonstrations to a later stage? Any boy understands that maps may be drawn to different scales, and this is almost the whole of the sixth book of Euclid. As for construction of tangents to a circle and "construction of common tangents to two circles," we would let a student draw these without introducing any idea of difficulty and we would ask him, by dropping perpendiculars on tangents from centres, to find the real points of contact. As soon as a boy can draw a right-angled triangle, measuring the sides and using arithmetic to find sines, cosines and tangents, he ought to begin trigonometry. If he knows the mere definition of *tan* A, he ought at once, by merely exercising his common sense, to be able to draw the angle the tangent of which is given. A common-sense knowledge of right-angled triangles is really a knowledge of solution of triangles in general. But until the artificial bulkheads between the various water-tight compartments of mathematics are swept away, we suppose that it will not be possible to give to very young schoolboys the power to solve trigonometrical problems. If the syndicate would condescend to study the elementary syllabuses of Science Subjects I. and V_{p} of the Education Department, we think these courses of studies might become much easier and much more valuable.

But is not ingratitude the meanest of sins? And may it not show wisdom in the syndicate that it avoids changes which may seem to be too sudden and too great? Besides, it is to be recollected that almost every candidate who has followed this course has also taken a course in experimental science, into which weighing and measuring, the uses of squared paper and logarithms, and the ideas of the calculus have entered in all sorts of commonsense ways. Even taken by themselves, the schedules mark a great step in our experiment of finding a method of teaching mathematics suitable for boys of the Anglo-Saxon race. A beginning has been made in disenchanting the English school system of those pedagogic dogmas which have tied teachers and pupils hand and foot. Teachers and examiners will ask for more and more freedom as they find that it is altogether good. Hitherto, the average English boy has believed himself to be stupid because he was unable to reason about things unknown to him; hitherto, the average English teacher of mathematics has thought of himself as a dull, tired usher because he has had no interest in teaching; in future, pupils and teachers will feel with complacent pride that they have come to their inheritance as thinking, useful human beings. We look forward to very great results, and we are not going to give credit in particular to any one of the ten or twenty names that rise before us of the men who have helped to make this reform. Those who are dead had their reward in knowing that they helped towards a reform that was certain to come; those who are alive have the reward of knowing that they were commissioned to keep alight the torches lit by their much-loved predecessors.

With the exception of the Society of Arts, no institution of the country has been so successful in initiating scientific reform as the British Association. A Committee was appointed in 1874 (the present writer is proud to think he was a member of it) for improving science teaching in schools, and another for improving mathematical teaching, and although the members of these Committees were mostly men of influence, their efforts led to no important results for many years. But ten years afterwards, the report of a British Association Committee on the teaching of science acted on the scholastic world like the prince's kiss in the story of the Sleeping Beauty, and in 1901 the British Association proceedings in the new Education Section acted in much the same magical way in relation to the teaching of mathematics. Many mathematical masters were feeling hopeless about reform, but without jealousy, with great enthusiasm, with the most wonderful forgetfulness of differences in small matters, they joined together to assist the British Association Committee of Mathematicians. There can be no doubt that this evidence of a desire for reform among the schoolmasters had a great effect upon the members of the Committee who were not in immediate touch with the schools. All the tact, patience and resourcefulness of a chairman eminent for these qualities might have been unavailing in dealing with a Committee the members of which were all men of great individuality had it not been for the schoolmasters' memorial. Anyone who knows the history of this reform must recognise its peculiarly English characteristics—the conservative clinging to past methods because of the recognisable good in them, even among the most radical reformers; the efforts of individuals in low and high positions gradually making converts in spite of the seeming hopelessness of reform; the unwillingness of men in high positions to lend their names to the movement, the virtue of which they were aware of, so long as they thought that only unrest and disturbance could accompany it; and their concerted action as soon as it was evident that a great reform was possible. And now, because it has occurred in the English way, we know that the reform is real, that it will have a fair chance, that it will go on year after year for many a year to come. This is no case of a thin end of a wedge, for no force is really required. It would be bad policy to make too great a change at once. Freedom has been given to teachers, a freedom much sighed for, a freedom which will create enthusiasm. Those who are most determined to make the reform complete are most anxious to proceed cautiously and to smother intemperate zeal.

JOHN PERRY.

THE THEORY OF THE GAS MANTLE.

A NUMBER of papers have been recently published which deal, either directly or indirectly, with the cause of the high efficiency of the incandescent gas mantle.[1] Space does not permit us to enter at all fully into the details of these papers, but it is of interest to consider some of the questions which they raise.

The high luminosity of the mantle and its still more remarkable dependence on a particular composition have long been recognised as facts calling for some special explanation, and many have been the hypotheses advanced to account for them. The simplest of these is that which

[1] "Zur Theorie des Auerlichtes," by W. Nernst and E. Bose (*Physikalische Zeitschrift*, 1900, i. 289).
"Theory of the Incandescent Mantle," by A. H. White, H. Russell and A. F. Traver (*Journal Gas Lighting*), lxxvii. p. 879, and lxxix. p. 892).
"Theory of the Incandescent Mantle," by A. H. White and A. F. Traver (*Journ. Soc. Chem. Industry*, 1902, xxi. p. 1012).
"The Conditions Determinative of Chemical Change and of Electrical Conduction in Gases and on the Phenomena of Luminosity," by Prof. H. E. Armstrong, F.R.S. (*The Chemical News*, May 23 and 30, 1902).
"The History of the Invention of Incandescent Gas Lighting," by Auer von Welsbach (*The Chemical News*, May 30, 1902, p. 254).

regards the mantle's luminosity as an ordinary high temperature effect; as showing how the phenomena are accounted for by this explanation, we may quote the view put forward by Mr. J. Swinburne (*Journal* of the Inst. Elect. Eng., vol. xxvii. p. 161). Mr. Swinburne will have nothing to do with selective emissivity, but states that "all bodies" (presumably solid bodies) "at the same temperature give out light of the same colour." The Bunsen flame, he argues, in which the mantle is immersed, is extremely hot, and the mantle's luminosity is due to its very nearly attaining this temperature. A bad radiator (such as thoria) will reach the same temperature as the flame, but as it radiates so little energy will give but little light; what light it does give, however, will be of high luminous efficiency. A good radiator (such as ceria) will radiate energy so fast that it will not attain anything like the flame's temperature. It is, therefore, only necessary to add sufficient ceria to the thoria to increase the emissivity enough to get a good quantity of radiated energy, but not enough to lower the temperature unduly, in order to get a composition giving a brilliantly luminous mantle. This explanation does not appear to us sufficient, especially when one considers that it is polished, and not white, bodies which are bad radiators, so that if it is legitimate to argue from their behaviour at low temperature, thoria would be expected to be but little inferior as a radiator to ceria or even carbon. Also there seems some reason to think that selective emission is more probably the rule than the exception (see, for example, the work of Nichols and Blaker, published in the *Physical Review*).

Le Châtelier and also Nernst (*loc. cit.*), arrive at the same final result as Mr. Swinburne—namely, that the mantle is so bright because it more nearly approaches the temperature of the flame than any other body similarly placed—but by a different argument. The experiments which they made led them to conclude that the emissivity of the mantle is poor in the region of the red rays; hence there is little energy lost in non-luminous radiations, and the mantle can in consequence come up to the high temperature of the flame, at which it begins to radiate well, especially in the region from the green to the violet. The selective emissivity of the mantle material has therefore a double effect; it increases the luminosity at a given (high) temperature, and it enables the mantle to attain a higher temperature than a black body, because the total loss of energy by radiation is diminished. Bunte, on the other hand, claims that the assumption of selective emissivity is unnecessary, and that the mantle is at a higher temperature than the flame (*Berichte* Deut. Chem. Ges., 1898, i. 5). This view is supported by experiments he performed, in which different substances were raised to incandescence in pairs in the inside of an electrically heated tube; no appreciable difference could be observed in the light given by carbon, thoria, ceria or the material of the mantles. It remains to be explained how the temperature of the mantle can be higher than that of the flame. This is due, he and Killing suggest, to the catalytic action of the ceria, which, by oscillating between a low and high state of oxidation, increases the rate of combustion at the mantle surface and so raises its temperature. The thoria is necessary, according to Killing, to give a large surface over which the ceria molecules are spread: and Bunte suggests that it also acts as an insulator between the ceria molecules, enabling them to maintain the high temperature that their catalytic action produces.

Obviously, the simplest method of testing the accuracy of some of these different hypotheses is to measure the temperatures of mantles of different composition. An attempt to do this has been made quite recently by Messrs. White, Russell and Traver (*loc. cit.*). The temperatures were measured by means of small thermocouples, and (by making measurements with couples of different sizes and so obtaining data for extrapolation) they claim to have arrived at a method giving with considerable certainty the temperatures of flame and mantle. Even if the accuracy of the absolute values thus obtained be impugned, the relative results are not so subject to the same objections. These experimenters find that the temperature of the mantles and flame is from 1500° C. to 1700° C.; that the mantle is at a slightly lower temperature than the flame and at very nearly the same temperature whatever its composition; and, especially, that a pure thoria mantle is at a slightly higher temperature than one of thoria and ceria. Some actual results illustrating these points may be quoted from their paper:—

Composition of Mantle. Per cent.	Temperature of Mantle. C.	Temperature of flame. C.	Candle-power per sq. in.
100 thoria	1560°	1630°	3·8
99·5 thoria & 0·5 ceria	1520°	1630°	34·0

The mantles used are said to have been identical in every respect except in their chemical composition. The differences in temperature are not very great, but, such as they are, they do not harmonise with the theory of le Châtelier and Nernst, since they show the thoria mantle to be the hotter; at the same time, they support this theory as against that of Bunte by showing the mantle to be at a lower temperature than the flame. The results also support the views of Mr. Swinburne, which require that the order of the temperature should be the same as that observed. In some other experiments, the results were less conclusive, the illumination varying from 2·5 to 48 candles with practically no temperature difference. Mantles with a high percentage of ceria were not tested. The authors themselves conclude that the illumination is to a greater degree a specific function of the material than it is of the temperature, and that the particular thoria-ceria mixture is a solid solution capable of transforming the heat of the flame into light more economically than any other substance yet known.

If this explanation is to be accepted, the mechanism by which this transformation is effected remains to be explained. In that part of the paper by Prof. H. E. Armstrong (*loc. cit.*) which deals with the question of luminosity, we find a suggestion as to what this mechanism is. Prof. Armstrong's paper is of a comprehensive and far-reaching character, dealing with many things besides luminosity in general and that of the mantle in particular, but it is only its bearing on these questions that we can consider here. Prof. Armstrong thinks that "luminosity and line-spectra are the expressions—the visible signs—of the changes attending the formation of molecules from their atoms, or, speaking generally, *that they are consequences of chemical changes*." Applying this to the Welsbach mantle, after referring to Bunte's hypothesis, he says, "this undoubtedly must be the case; but I would go further, and regard *the chemical changes* occurring at the surface as the direct seat, or origin as it were, of the luminosity. Probably a higher oxide is alternately decomposed and reformed—in other words, *the process is one of oscillatory or recurrent oxidation*." This process, then, gives direct birth to the luminous radiations and accounts for the high efficiency of incandescent oxides generally, such as the lime and zirconia light and the Nernst glower. A somewhat similar conclusion is arrived at by Dr. Auer von Welsbach (*loc. cit.*), who considers that the ceria when in one or other state of oxidation can form a compound with the thoria: hence "if reduction takes place, there is also decomposition, and if oxidation, there is recombination of these elements; these reactions may go on several million times a second, and molecular shocks are produced which give rise to luminous oscillations of the ether, and

the body becomes incandescent." Both Prof. Armstrong and Dr. Welsbach attribute the importance of the special composition of the mantle to this particular mixture forming a solid solution of a dilution favourable to the occurrence of the oscillatory changes.

We have endeavoured to put forward a summary, of necessity brief, of some of the principal theories which have been advanced to account for the luminosity of the mantle. Although it is true that some of these theories, if regarded as individually sufficient to account for the phenomena, lead to conclusions mutually inconsistent, yet there is no reason why they should not all contain some part of the truth, unless the experiments of Messrs. White, Russell and Traver be considered as sufficiently conclusive against the idea of the mantle being hotter than the flame. Such a result does not preclude the possibility of catalytic action, for the additional energy thereby developed may be all dissipated in luminous radiations. It seems that the most satisfactory explanation that the present experimental data justify is that the high luminosity is due to a combination of the good radiating power, the high temperature and the selective emissivity of the mantle. The first accounts for the high candle-power at the temperature attained; the second, which is due partly to the selective emissivity diminishing the useless radiation losses and partly, no doubt, to the catalytic action of the ceria molecules, is responsible for the high luminous efficiency of the light, so far as this is a function of the temperature; whilst the third, most probably due to the recurrent chemical changes, accounts for the high luminous efficiency so far as it is a function of the material. Thus all these causes, operating together and assisting one another, combine to produce one of the most efficient artificial illuminants that the ingenuity of man has devised.

MAURICE SOLOMON.

THE EXPLANATION OF A REMARKABLE CASE OF GEOGRAPHICAL DISTRIBUTION AMONG FISHES.

MOST text-books and papers discussing geographical distribution have made much of the range of a genus of small fishes, somewhat resembling trout, the Galaxias, commonly described as true fresh-water forms, which have long been known from the extreme south of South America, New Zealand, Tasmania and Southern Australia. The discovery, within the last few years, of a species of the same genus in fresh water near Cape Town, whence it had previously been described as a loach by F. de Castelnau, has added to the interest, and has been adduced as a further argument in support of the former existence of an Antarctic continent. In alluding to this discovery when discussing the distribution of African fresh-water fishes in the introduction to my work "Les Poissons du Bassin du Congo," in 1901, I observed that, contrary to the prevailing notion, all species of Galaxias are not confined to fresh water and that the fact of some living both in the sea and in rivers suffices to explain the curious distribution of the genus; pointing out that in all probability these fishes were formerly more widely distributed in the seas south of the tropic of Capricorn and that certain species, adapting themselves entirely to fresh-water life, have become localised at the distant points where they are now known to exist. Although as recently as October last the distinguished American ichthyologist D. S. Jordan wrote (*Science*, xiv. p. 20) "We know nothing of the power of Galaxias to survive submergence in salt water, if carried in a marine current," it is an established fact, ascertained some years ago by F. E. Clarke in New Zealand and by R. Vallentin in the Falkland Islands, that *Galaxias attenuatus* lives also in the sea. In New Zealand, it periodically descends to the sea, where it spawns, from January to March, and returns from March to May. In accordance with these marine habits, this species has a much wider range than any of the others, being known from Chili, Patagonia, Tierra del Fuego, the Falkland Islands, New Zealand, Tasmania and Southern Australia.

I now wish to draw attention to a communication made by Captain F. W. Hutton in the last number of the *Transactions* of the New Zealand Institute (xxxiv. p. 198), "On a Marine Galaxias from the Auckland Islands." This fish, named *Galaxias bollansi*, was taken out of the mouth of a specimen of *Merganser australis* during the collecting excursion to the southern islands of New Zealand made in January, 1901, by His Excellency the Earl of Ranfurly.

It is hoped that by giving greater publicity to these discoveries, the family Galaxiidæ will no longer be included among those strictly confined to fresh waters and that students of the geographical distribution of animals will be furnished with a clue to a problem that has so often been discussed on insufficient data. As observed by Jordan (*l.c.*), "all anomalies in distribution cease to be such when the facts necessary to understand them are at our hand."

Of the fresh-water species of Galaxias, eight are known from New Zealand and the neighbouring islands, seven from New South Wales, three or four from South Australia, one from West Australia, two from Tasmania, seven from South America, from Chili southwards, and one from the Cape of Good Hope.

G. A. BOULENGER.

LOCAL MAGNETIC FOCUS IN HEBRIDES.

IN the course of a recent survey in the Hebrides, Captain A. Mostyn Field, in H.M.S. *Research*, found and examined an area in the entrance of East

FIG. 1.—Examination in 1902 by H.M.S. *Research* of an area of magnetic disturbance in East Loch Roag, Lewis.
Lines of equal disturbance westerly from the norma declination shown in continuous line.
Lines of equal disturbance easterly from the normal declination shown in broken line.
Normal declination 22° W.
The figures express degrees and decimal parts.
Depth of water over area from 15 to 17 fathoms.

Loch Roag, Lewis, where there is considerable local magnetic disturbance. A plan showing the deviation from the normal declination of the compass needle at

different positions in the area is here given, and will probably be of interest. Unfortunately, no special magnetic instruments were on board, and therefore no observations on the dip or force could be made. It is hoped to complete the observations later. The maximum deviation is 11° W.

The remarkable point in this instance is not only the magnitude of the disturbing force, the depth of water and therefore the distance of the compass from the bottom being 100 feet, but that the north point of the needle is repelled from the apparent line of magnetic disturbance, and not attracted towards it as is usually the case in northern latitudes. W. J. L. WHARTON.

Admiralty, November 15.

THE NEEDS OF KING'S COLLEGE, LONDON.

A PUBLIC meeting was held on Wednesday, November 19, under the presidency of Lord Selborne, to assist the appeal being made to secure the adequate endowment and equipment of King's College, London. Many men prominent in every department of human learning were present, among whom may be mentioned the Bishops of London and Rochester, Lord Glenesk, Sir A. W. Rücker, F.R.S., Sir John Wolfe Barry, F.R.S., Sir Philip Magnus, Sir W. H. Preece, F.R.S., Mr. A. Siemens, Profs. Jeffrey Bell, W. G. Adams, F.R.S., J. M. Thomson, F.R.S., W. D. Halliburton, F.R.S., W. H. Hudson and D. S. Capper.

The following message from the King was read by the Bishop of London:—

"His Majesty is thoroughly in sympathy with the proposal to raise by subscription a large fund for the endowment of King's College as a constituent of the newly-developed University of London, and wishes the movement for that purpose all success."

The Prime Minister also sent a letter in support of the appeal. He remarked, in the course of the letter, that "It would be a serious misfortune to the interests of higher education in the metropolis if, through the burden of debt and the want of proper endowment, King's College was not able to do its part in the great work which I trust lies before the reconstituted University. Higher education cannot be made self-supporting, and is, nevertheless, one of the greatest of our national needs."

Lord Selborne, in explaining the objects of the meeting, referred in high terms of praise to the work accomplished in the past by King's College in training men adequately to undertake a noble part in the civilisation and humanisation of the world. During the course of his remarks, he referred to the value of science in the following words, which we quote from the *Times* report:—

They were met to try to help King's College to go on in the future preaching the gospel of learning and of work, the gospel of research and applied science on which the real strength of the Empire was built. Was it a great thing that King's College, with its history and distinctive features, should appeal to them for that endowment which was absolutely necessary? That effort was only part of a great movement through which they were passing at this moment. There was a fresh wave of enthusiasm for university teaching sweeping over the land. In London, in the provinces, there were movements for the extension of universities, for the founding of universities, for the development of higher education. Why? He thought it was because there was a general belief that in the university teaching of this country men were taught what they wanted to know by men who knew how to teach. They felt that the higher part of education was not lost sight of in these universities, certainly not in King's College.

It was unanimously resolved, on the motion of Sir R. Jebb,

"That, in view of the distinguished services which have been rendered by King's College to higher education and research in London, it is of the highest importance that the work of the College, in its new connection with the University of London, should receive support adequate for its effective continuance and progress."

In seconding the resolution, Sir J. W. Barry said:—

It was necessary to bring before all interested in the wellbeing of the University of London the absolute necessity of the cultivation of science and the promotion of research. They knew the story of the exultant professor who said he was investigating a subject which could not be of any use to anybody, and that was why he was so much interested in it. But that was probably only a partial view of that professor, as experience showed that researches which appeared to be of no practical use often turned out to be most valuable adjuncts to human knowledge. What was wanted was not merely to educate workmen in a technical way, but to educate masters and directors. There was no longer a possibility of the great manufactures of this country being conducted successfully without scientific knowledge from top to bottom of the whole of the people engaged.

A resolution proposed by the Bishop of London and seconded by Sir Douglas Fox pledged the meeting to use every effort to raise a sum sufficient to secure "the liberation of the College from debt, the maintenance of the efficiency of the College in laboratories and equipment for higher teaching and research, and the adequate endowment of its professorships."

NOTES.

IT is with deep regret that we announce the death of Sir William Roberts-Austen, K.C.B., F.R.S., on Saturday last, at the age of fifty-nine.

THE Academy of Natural Sciences of Philadelphia has, on the recommendation of its special committee, consisting of Messrs. Theo. D. Rand, Amos P. Brown, R. A. F. Penrose, jun., and H. F. Osborn, has conferred the gold medal of the Hayden memorial geological award for 1902 on Sir Archibald Geikie, F.R.S.

THE trawling vessel s.s. *Huxley*, which has been chartered and fitted out by the Marine Biological Association for service in connection with the International North Sea Investigations, will be alongside Fish Wharf, Billingsgate (by London Bridge) during the afternoon of Tuesday next, December 2. The president of the Association has issued invitations to an inaugural inspection of the vessel to be held on that day.

A NEW building to accommodate the French Academy of Medicine was opened on Tuesday, M. Loubet and M. Chaumié, Minister of Education, being among the guests present. Dr. A. Riche, president of the Academy, gave an address upon the history of the Academy and the contributions made to medical science by its members. "The Academy is happy," he is reported by the *Times* correspondent to have said, "to take possession of a dwelling worthy of France, which it owes to the liberality of the Government of the Republic, and whereby it obtains the means of better serving the interests of the public health."

THE formation of a British committee to take part in the movement for the erection of a memorial statue of the late Prof. Virchow at Berlin was referred to a fortnight ago (p. 35). The inaugural meeting of the committee was held on Friday last, when Lord Lister, who was in the chair, described the origin of the movement and the ready support that has been given to it. A general committee has been formed containing nearly one hundred names of men distinguished by their work in various branches of natural science and medicine; and a form of appeal

has been decided upon. At Friday's meeting, Lord Lister was appointed chairman of the memorial committee; Lord Avebury hon. treasurer; and Sir Felix Semon hon. secretary. It is to be hoped that the response to the appeal for subscriptions will be prompt and generous, so that Great Britain may take a worthy share in the erection of a monument to a man whose genius was used to benefit the whole world. Contributions should be sent to "the Hon. Treasurer of the Virchow Memorial, care of Messrs. Robarts, Lubbock, and Co., 15 Lombard Street, London, E.C.," who will send an acknowledgment to the individual contributors. When the list has been closed, the hon. treasurer will forward the amount to the treasurer of the Berlin committee, together with a list of the contributors, but the amount of the individual contributions will not be stated. All who appreciate Virchow's services to science and humanity should, therefore, not hesitate to pay their tribute to the memory of one of the greatest men of our time.

THE Liverpool correspondent of the Central News states that the Nobel prize of 3000*l*. for researches in connection with malaria will be a personal one to Major Ross, principal of the Liverpool School of Tropical Medicine. According to the Stockholm correspondent of the *Daily Chronicle*, the prize for medicine will be awarded to Prof. Finsen, the Danish discoverer of the treatment by red light for lupus, and the prize for physics to Prof. S. A. Arrhenius.

THE directors of the Ben Nevis Observatories intimated, in a memorandum dated June, 1902, that the observatories at the top of Ben Nevis and in Fort-William were to be discontinued at the beginning of October, 1902. But, in consequence of a proposal by the Treasury to make an inquiry into the administration of the grant to the Meteorological Council, it was widely felt that an effort should be made to keep the observatories at work until the inquiry had been completed. The directors are now able to state that they have succeeded in obtaining the necessary funds, and that there will be no stoppage of the work at the observatories until October, 1904; that is, the work will go on as hitherto for at least two more years. One generous donor is to provide the whole funds necessary for the second year. This prolongation will give ample time to make such arrangements as may be consequent on the report of the committee of inquiry.

A VIOLENT shock of earthquake is reported to have occurred during the night of November 20 at Oued Marsa, in Algeria.

DR. GILBERT T. MORGAN has succeeded Prof. W. P. Wynne, F.R.S., as editor of the *Journal* of the Chemical Society.

THE inaugural address prepared by Mr. J. Swinburne, president of the Institution of Electrical Engineers, will be delivered at an extra meeting, to be held on Thursday, December 4. Mr. Swinburne's illness prevented the address from being read at the meeting of the Institution on November 13.

OWING, it is supposed, to a defect in the heating apparatus, a fire broke out at midnight of November 18 in the Zoological Gardens at Amsterdam. The outbreak started in the birds' gallery, the centre of which is occupied by rare apes. Fortunately, the loss of life was not great, though Keetje, the popular female orang-utan, was suffocated.

LORD EDMOND FITZMAURICE, M.P., chairman of the Wilts County Council, at the last meeting of the Council made a statement with regard to his negotiations with Sir Edmund Antrobus respecting Stonehenge. Though nothing has yet been definitely decided upon, Lord Edmond expects to be able to place before the Council, in February next, a scheme to arrange satisfactorily for the future of Stonehenge.

PROF. GUIDO CORA informs us that a severe snowfall has occurred in several parts of Piedmont. At Costigliole d'Asti, during the morning of November 19, the snow attained a height of a foot (30 cm.) in the most exposed spots. Another fall of snow took place on November 20-21. During the nights, the temperature has been very severe, and in the morning of November 23, at 8 a.m., the thermometer reached $-7°$ C., an extraordinarily low temperature for such a season. In Alessandria and Ivrea, also on November 19, the fall of snow was 20 cm. and 30 cm. thick.

A CREMATORIUM, established by the London Crematorium Company (Limited), was opened at Golder's Green, Hendon, on November 22, when an address was given by Sir Henry Thompson. The crematorium at Woking is too far from London to be of much use to the metropolis, but it is hoped that the institution now available, being within five miles of the Marble Arch, will do much to supply a real deficiency.

THE *Athenaeum* announces that the Vienna Academy of Sciences is making the necessary preparations for a fifth expedition out of the funds placed at its disposal by the Treitzsche Stiftung. It is to start in January, 1903, under the leadership of Hofrat Franz Steindacher, the director of the Vienna Natural History Museum. Dr. Pentor, of the same institution, will accompany the expedition as entomologist, and Othmar Reiser, the director of the Bosnian Museum at Sarajevo, as ornithologist. The expedition will land at Paranagua, in Brazil, and thence proceed to the study of the fauna of the hitherto unexplored districts of Piauhy and Maranhao.

A CORRESPONDENT writes:—"A semi-official announcement in the *Transvaal Leader* of October 23 records the formation of a regularly constituted Department of Agriculture in the Transvaal, with Mr. F. B. Smith, the recently appointed agricultural adviser to Lord Milner, as director. Forestry will be represented on the staff by Mr. Chas. E. Legat, of Edinburgh University, from the Cape Forestry Department; fruit by Mr. Davis, late manager of Mr Rhodes's fruit farms; and poultry by Mr. Bourlay, from England. A veterinary branch has been created, but the appointment of principal veterinary surgeon has not been filled. The *Agricultural Journal* was taken in hand some little time back, Mr. Burton being editor. The appointment of a forester has not been made a moment too soon, for he must select a suitable place and set about establishing a Government nursery of fruit and forest trees on the lines of the Government nurseries at Tokai, near Cape Town, where special attention is paid to the propagation of the splendid indigenous timber trees of South Africa. It is much better to plant stretches of veldt with wattles and gums than not to plant them at all; but where these grow, yellow-wood, laurel, assegai, Cape ash and white pear will also grow, than which there is no better timber for cabinet and waggon work. Afforestation should go hand in hand with irrigation in conserving the rainfall of the country."

IN the opening address which Sir William Preece delivered at the Society of Arts on November 19 (published in the *Journal* of the Society for November 21), he showed that the commercial conduct of industrial processes arising from the practical application of discoveries follows distinct laws, which may be said to constitute a science of business. Selecting the industries of water, gas, railways and telegraphs, a series of diagrams was given to exhibit graphically the comparative rates of growth of capital, revenue and expenditure. Several directions in which advance is necessary if Great Britain is to compete successfully with other progressive nations were mentioned. In the course of his address, Sir William Preece said:—"The Germans have an admirable Intelligence Department all over the world. If

any electric development is foreshadowed or suggested in any one of our colonies, especially those in which my firm acts as consulting engineer, we at once receive intimation of the fact from Germany and often from America. We never once have received similar information from any British source! I have endeavoured, to the best of my ability, on every occasion to point out that the retardation in commercial progress in the United Kingdom is not due so much to want of scientific education in the men as in the masters. It is the masters who have allowed the Americans and the Germans to oust them out of their own markets, not by any superiority in the quality of their goods, but by lower prices, by superior knowledge of the demands of the markets, by the establishment of new markets, by better direct communication with foreign countries, by superior methods of business ways, by establishing regular intelligence departments, and, above all, by possessing and exercising superior commercial technical knowledge. There is a science in business as in manufacture. We want our business men to be technically educated. Their brains must be trained as the Germans have been trained—to guide their business habits by language, observation, generalisation and common sense. They must lay aside the habits of their fathers. It is very satisfactory to find our new Universities establishing commercial faculties."

WE have received from Mr. G. G. Davis, director of the Meteorological Service of the Argentine Republic, vol. xiv. (1901) of the *Anales* (xi + 520 large quarto pages). At the time of the last published organisation report (1897), the system embraced 156 stations of various classes, including a few in Paraguay; six stations are provided with self-recording instruments of the most approved patterns, and the observations are all taken and reduced with much care. At four of the principal observing stations, elaborate discussions of the climate, under each element, are published in the volume in question, and form a very valuable contribution to the meteorology of South America.

WE learn from the Report on the administration of the Meteorological Department of the Government of India in 1901–2 that at the end of the year the total number of observatories was 235, of which 186 were maintained by the Government. Seven only were of the first class, furnished with automatic instruments for continuous records of the various meteorological elements. Rainfall was observed at 2389 stations, and seismological observations were satisfactorily recorded by means of Milne's self-registering instrument at three stations; the curves of the latter have been forwarded to the Earthquake Investigation Committee of the British Association. The movements of the upper clouds by means of photogrammeters have already been published for Allahabad; similar observations have recently been made at Simla, and the results are ready for publication. The important work of collection of observations from ships' logs has been continued with much activity at Bombay and Calcutta, and the results are utilised in the preparation of pilot charts, giving month by month the normal meteorological conditions over the Indian seas. These seas were remarkably free from severe storms during the year ending March 31, 1902, there being only seven disturbances, of which four were of slight intensity; due warning was given in all cases to the ports concerned.

THE most recent addition to the valuable series of wind charts published and in preparation by the Meteorological Office shows the mean direction and force of winds round those parts of the coasts of South America which lie south of the equator ("Wind Charts for the Coastal Regions of South America," Meteorological Office Official Publications, No. 159). The coastal regions are broken up into areas from two to five degrees "square," and in each is shown a wind rose, represented by arrows which fly with the winds and show the frequency of the winds by their length, and the force by their thickness. The charts embody the results of 264,639 observations of wind, the numbers ranging from 20,033 for September to 24,072 for January. In addition to the wind roses, mean isobars are given for the same areas. The atlas forms an advance part of the series of charts for the South Atlantic Ocean and the eastern margin of the South Pacific Ocean, in course of preparation under the direction of Commander Campbell Hepworth. Maps of this kind furnish material to the investigator as well as to the navigator which is absolutely inaccessible elsewhere. As illustrating the unique value of such charts, the light thrown on the distribution of cyclonic winter rainfall far up the east coast of South America may be mentioned, a distribution which no charts of mean pressure would account for. We look forward with the more interest to the completed charts of the South Atlantic, inasmuch as they will give a still more extended opportunity of studying the external relations and internal eeonomy of an oceanic area of low mean pressure.

WE have received from Messrs. J. W. Gray and Son a pamphlet on scientific protection against lightning, written by Mr. A. Hands. The writer gives a careful explanation of the principles which must be observed in erecting lightning conductors; as the pamphlet is written in non-technical language, it is to be hoped it may be the means of disseminating information amongst the public, since there are few subjects on which more ignorance and superstition exist. The importance of careful protection may be gathered from the fact that Mr. Hands estimates the damage caused annually by lightning in this country alone at from 50,000*l.* to 100,000*l.*

THE *Engineering Magazine* for November contains an interesting review of wireless telegraphy from the pen of Mr. A. F. Collins. The writer gives a brief historical *résumé* and explains the theoretical basis of the subject, and then proceeds to a detailed examination of the different systems of Hertzian telegraphy which have been developed in the past few years. Those who have attempted to follow the development know that the number of workers has been large and that each has evolved a system having certain distinctive features, and they will welcome an account which describes and illustrates the peculiarities of each. Mr. Collins describes the systems worked out by Mr. Marconi in England, Messrs. Slaby and Arco and Braun in Germany, Messrs. Popoff and Ducretet in France, Messrs. Fessenden and de Forest in America, Senor Severa in Spain, and the repeating system tried by M. Guarini in Belgium.

Die Zeitschrift für das gesammte Brauwesen publishes a highly interesting notice, by Dr. Klöcker, of Prof. Emil Chr. Hansen, written on the occasion of the celebration of the twenty-five years' connection of the eminent investigator with Carlsberg. Hansen's early years shadowed nothing of the career which he ultimately carved out for himself in the scientific world; indeed, a talent for portrait painting led him to migrate from his home at Ribe to Copenhagen with the intention of studying art. Here, however, he worked hard at science, and after passing his examinations at the Polytechnik, he devoted his ability and indomitable energy to botanical studies, and in 1876 he obtained the gold medal of the University for his treatise on Danish manure-moulds. In 1879, he was appointed director of the physiological department of the Carlsberg Laboratory, founded by the enlightened brewer, J. C. Jacobsen. Hansen's work on yeasts has made his name known in every quarter of the globe, and his methods and discoveries have inaugurated a new era in the history of brewing. In the new Fermentation Institute opened about two years ago, of which Hansen is director, neither money nor skill has been spared to supply him

and his able assistants, Drs. Kocker and Schiönning, with very possible facility for carrying on researches which have rendered Carlsberg so famous. The scientific world, indeed, is apt to forget, dazzled by the renown of the laboratory, that a successful brewery exists at Carlsberg which originally called into existence and supplied the wherewithal for the equipment and conduct of Hansen's Institute.

THE firms of Heraeus, of Hanau, and Dr. Siebert and Kühn, of Cassel, have undertaken the commercial manufacture of flasks, &c., from quartz. The quartz is melted in an oxyhydrogen furnace, and worked and blown to the desired shape. At present, the cost of these quartz vessels is somewhat high, but if their use becomes at all general, it is hoped that it will be possible to considerably reduce it. The accompanying photograph, taken from the *Zeitschrift für Elektrochemie* of November 13, shows one of the vessels made by these firms; it will be seen that the art of turning out such finished work as in glass blowing has not yet been attained. We recently pointed out some of the

valuable properties that quartz vessels possess, in a note on a paper by Mr. Hutton on the fusion of quartz in the electric furnace; we do not know whether Mr. Hutton's process has been taken up as yet with a view to its commercial use. It is a matter for regret that this new and possibly very important industry is apparently to be added to those which our manufacturers at home lack either the ability or energy to tackle with success.

FROM the Report of the Medical Officer of Health for the City of London, we gather that a commendable sanitary supervision is being exercised within the City area. A detailed inspection of kitchens of restaurants, &c., was commenced early in the year. With regard to tuberculosis, the Medical Officer says:—"Although probably not the most important, there can be little doubt as to the causal effect of tuberculous meat and milk," and 24 samples of milk were examined by Dr. Klein for the presence of the tubercle bacillus, but with negative results. During 1901, of 392 samples of milk analysed, 21·2 per cent. were found to be adulterated; but of 30 samples of milk taken from the churns on their arrival at the railway stations from the country, all were of excellent quality, showing that it is the City dealer who is the delinquent.

We have received from the author, Dr. R. von Wettstein, a copy of an essay on neo-Lamarckism and its relation to Darwinism, published in the *Sitzungsberichte* of the German Association of Naturalists and Artists.

The whole of parts iii. and iv. of the *Bulletin* of the Society of Naturalists of Moscow is devoted to an elaborate and profusely illustrated memoir, by Monsieur N. K. Koltzoff, on the development of the skull of the lamprey, *Petromyzon planeri*, in relation to the doctrine of the segmentation of the vertebrate head. It is concluded that the lampreys and their immediate relatives are descended from an ancestral form—the hypothetical Octotrema—furnished with eight pairs of gill-slits. This, in turn, was derived from an earlier form with a still larger number of slits.

To the issue of *La Belgique Coloniale* of November 9, Dr. Forsyth Major contributes some important notes on the okapi skins and skeleton received from the Congo Free State in Belgium, and placed at his disposal for description. The specimens appear to demonstrate that there are two forms of okapi, distinguishable from one another by size, colour, the striping on the legs and the proportions of the skull. For the one represented by the Belgian examples, the author suggests the name *Ocapia lebrechtsi*, in honour of the Secretary of the Interior for Belgium. This form is now definitely known to be horned in the male and hornless in the female; but the author does not at present consider himself justified in stating that the same condition obtains in the form represented by the mounted hornless skin in the Natural History Museum.

IN a paper published in the *Bulletin* of the American Museum (vol. xvi. art. 25), Dr. J. E. Duerden emphasises the importance of boring algas in the disintegration of corals. "Nearly every fragment of dead coral in the West Indies is marked by a number of green specks, indicating the tunnels of an alga, and these in time lead to the breaking up of the whole mass." The author is inclined to believe that boring algas have more to do with the formation of lagoons in coral islands than has the solution of the coral-substance by the carbonic acid contained in the water. "It is just in such quiet spots as lagoons that the various boring algæ would be expected to grow most favourably, and by their incessant ramifications lead to the ultimate disintegration of any block of coral, following it even when reduced to fragments." Nevertheless, it is not to be assumed that this is by any means the sole agency in lagoon-formation.

THE whole of parts i. to iii. of vol. xxvi. of *Notes* from the Leyden Museum is occupied by an important paper on the fresh-water fishes of Borneo, by Prof. L. Vaillant, of the Paris Museum. It appears that the expedition recently dispatched to Borneo by the Society for the Encouragement of the Scientific Exploration of the Dutch Colonies succeeded in ascending a river on one side of the island and descending by another on the opposite side, thus effecting a complete traverse. In spite of many difficulties, a large collection of fresh-water fishes was made, which includes a number of new species. The importance of the collection lies, however, in the proof afforded, that the fresh-water fish-fauna of Borneo differs essentially from that of Celebes—notably in the presence of carps (Cyprinidæ) and cat-fishes (Siluridæ), which are totally wanting in the latter island. It is incidentally mentioned that the fresh-water fishes of Palawan and Balabac are intermediate between those of Borneo and the Philippines, with a preponderance of Bornean types.

THE publications in a European language of the Earthquake Investigation Committee of Japan have now reached their eleventh number. This last issue, which is by Dr. F. Ōmori,

treats of the macro-seismic measurements made in Tokio between September, 1887, and July, 1889. These measurements, which are given in tabular forms, refer to the periods, amplitudes, directions and durations of different earthquakes. One map shows the origins of the earthquakes which were felt in Tokio, many of which are within a radius of 30 miles from that city, whilst all, with the exception of two or three, originated at a distance of not more than 75 miles. A second map shows the distribution of origins of earthquakes which were not felt in Tokio. The distance of these from that town approximately vary between 10 and 130 miles. These various origins may be divided into zones. One of them, which is suboceanic, runs parallel with the eastern coast line. The remainder are inland, and practically run from the backbone of the country at right angles to the Pacific coast.

AMONG the recently published memoirs of the Geological Survey are two relating to the coal-fields of North Staffordshire and South Wales. Both are explanatory of the new series Geological Survey maps. "The Geology of the Country around Stoke-upon-Trent," by Mr. Walcot Gibson and Mr. C. B. Wedd, is accompanied by two editions of the map, sheet 123, one with and one without the drift deposits, and both are colour-printed. This is a distinct improvement on the old hand-coloured maps, and the execution by the Ordnance Survey leaves nothing to be desired. The price also (1*s.* 6*d.*) is very moderate. The memoir contains a concise account of the Pottery Coal-field, and it will be noticed that the higher portions of the Coal-measures, previously regarded as Permian, are now subdivided and represented on the maps. The recognition of their true position has a very important bearing on further explorations for coal in the northern-midland area. The Triassic and superficial deposits are described, and there is a chapter on economic and applied geology. "The Geology of the South Wales Coal-field, part iii., the Country around Cardiff," is by Mr. A. Strahan and Mr. T. C. Cantrill. It is likewise an explanation of the geological map, sheet 263, which at present has been issued only in the hand-coloured form. The area described is just outside the limits of the great coal-field, but it includes the bordering rocks of Lower Carboniferous and Old Red Sandstone, and a little area of Silurian rocks by the Rhymney River. It also takes in a small portion of Somerset, near Weston-super-Mare. Resting irregularly on the older formations are the Keuper conglomerates and marls, the Rhætic beds and the Lower Lias. A particular description is given of the Rhætic beds, as they first received recognition by the Geological Survey in the conspicuous headland of Penarth. The Glacial and post-Glacial deposits, the water-supply and economic products receive due attention, and there is a full bibliography of geological books and papers relating to the South Wales Coal-field.

THE Irish gold ornaments which a few years ago were acquired by the British Museum have been the source of much departmental correspondence and opposed opinions, the excitement being due to the fact that these valuable and interesting specimens are lodged in the British Museum rather than in the Irish National Museum in Dublin. One argument for their retention in London was that, although they were found in Irish soil, there was no proof that they were of Irish manufacture. In the current number of the *Journal* of the Royal Society of Antiquaries of Ireland (part iii. vol. xxxii. p. 211), there is a paper by Mr. R. Cochrane which conclusively proves that these are genuine Irish objects, and Mr. Cochrane concludes that these *ex voto* objects, especially the golden boat, were connected with St. Columba's voyage to Drumceat, in A.D. 575 or 596, when he was accompanied by the Scottish King Aedan, and their deliverance from the dangers of shipwreck may have furnished the *motif*. There is a note substantially to the same effect, by the Rev. J. M'Keefry, in the same *Journal* (p. 266). Mr. Cochrane's paper is illustrated by a map and several illustrations borrowed from Mr. Arthur J. Evans's paper "On a Votive Deposit of Gold Objects found on the North-west Coast of Ireland" (*Archaeologia*, vol. lv. p. 391).

THE first part (pp. 424, figs. 412) of a new "Lehrbuch der vergleichenden Anatomie," by Prof. B. Haller, of the University of Heidelberg, has just been published by the house of Gustav Fischer, Jena. The work will be reviewed when it has been completed.

THE September issue of *Himmel und Erde* contains a very readable article, from the pen of Dr. H. Wagner, on natural colouring matters. Many interesting facts concerning the early history of these colouring matters are detailed, and the successful attempts at the replacement of several of these by synthetic products are described. In another article, by Herr Kürchhoff, an account is given of the trials which have been made with turbines as motive power on ships.

A FOURTH edition, revised and enlarged, of Prof. R. C. Carpenter's book on "Heating and Ventilating Buildings" has recently been published. In the review of the first edition of the work, in our issue for February 27, 1896, the author was congratulated on producing a really good book on a subject seldom treated scientifically. It is gratifying to find that the book has met with the success it deserves. In its revised form, it should continue to be used largely by heating engineers and architects. The book is published in this country by Messrs. Chapman and Hall, Ltd.

THE little book edited by Prof. Perry, F.R.S., containing an account of the discussion on the teaching of mathematics which took place at the Glasgow meeting of the British Association in 1901, has reached a second edition. The book is enlarged by the addition of the Report of the British Association Committee upon the Teaching of Elementary Mathematics (drawn up by the chairman, Prof. Forsyth, F.R.S.) which was presented at the Belfast meeting this year, and of the letter addressed to this committee by twenty-two mathematical masters in public schools. The book is published by Messrs. Macmillan and Co., Ltd., at 2*s.* net.

THE first part of a new volume (the third) of the "International Catalogue of Scientific Literature" has been published. The subject is "Physiology, Including Pharmacology and Experimental Pathology," and the second part of the volume referring to it will be issued shortly. The publication of the physiology volume in two parts has been considered advisable, instead of waiting until all the material for the year 1901 has been collected, but in future years, when the organisation of the work has been fully developed, the volume on physiology will be issued as one publication each year. The general scheme of the "International Catalogue" may be judged from the notices of the two volumes on botany and chemistry in NATURE of July 3 and September 4 (vol. lxvi. pp. 217 and 436). The first annual issue will consist of thirteen complete volumes and four volumes made up of two parts each. Three instalments have now been published, and of the remainder of the issue four are announced as in the press and fourteen in preparation. The price of the complete issue is 18*l.*

THE products of the decomposition of normal cupric acetate under the influence of heat have been frequently investigated, but no perfectly definite results have been obtained. Messrs. Harcourt and Angel, as the result of a very careful research, have found that the decomposition products are acetic acid, water, cuprous acetate, carbon dioxide, carbon monoxide and a residue containing copper, carbon and small quantities of oxygen and hydrogen. A trace of acetone is also obtained as a result of the decomposition.

SOME interesting facts concerning the velocity of crystallisation have been found as the result of an investigation by Dr. von Pickardt, published in the current number of the *Zeitschrift fur physikalische Chemie*. The velocity of crystallisation of super-cooled benzophenone is diminished to the same extent when equimolecular quantities of the most various substances are dissolved in it. The diminution of the velocity for any one dissolved body is, moreover, not proportional to its concentration, but to the square root of this. The regularities which have been observed may be utilised in a practical way for the determination of the molecular weights of substances dissolved in the crystallising medium.

A NEW fortnightly journal—the *Biochemisches Centralblatt*—is to make its appearance very shortly. The editor is Dr. Carl Oppenheimer, and the directors of the undertaking are all men well known for their contributions to biochemistry. It is not intended that the new journal shall serve as a medium for the publication of original papers; its chief object will be to give an abstract of all papers dealing with biochemical subjects published in other journals. The only original contributions which will find a place in the *Centralblatt* will be reviews of the condition and progress of small specialised branches of the subject, and it is proposed that each fortnightly issue shall contain such a *résumé*. The first number will appear early in December. The publishers are Gebrüder Borntraeger, Dessauer Strasse 29, Berlin S.W., and the yearly subscription is 30 marks.

THE examination of the electrical conductivity of a large number of substances dissolved in liquid hydrocyanic acid by Messrs. Kahlenberg and Schlundt (*Journal of Physical Chemistry*, October, 1902) has shown that while some salts are not such good conductors as their corresponding aqueous solutions, others conduct much better. Solutions of acids in liquid hydrocyanic acid are generally much poorer conductors than aqueous solutions, and the authors conclude that electrolytic conducting power is essentially determined by the specific nature of the compound formed when solute and solvent act on each other to form the solution. Certain chemical changes which have been investigated in hydrocyanic acid solution present remarkable peculiarities. It is found, for instance, that whereas trichloracetic acid readily attacks metallic magnesium and sodium carbonate, it has no action on zinc or calcium carbonate.

THE question of the influence of moisture on the combination of hydrogen and chlorine has been advanced another stage by the recent experiments of Messrs. Mellor and Russell. Great precautions were taken to ensure the purity of the gases used in the experiments, the hydrogen being prepared by the action of steam on metallic sodium and the product purified by absorption in palladium. Pure chlorine was obtained by the electrolysis of fused silver chloride. After the gases had been left in contact with phosphorus pentoxide for nine months in the dark, it was found that a small spark at once caused a violent explosion, and complete combination took place. The mixture of dry gases could, however, be heated to 450° C. without explosion taking place, whereas a moist mixture in a similar bulb exploded at about 260° C. With the dry mixture it was further found that in sunlight no explosion takes place, but that the combination of the gases is very slow. The experiments show clearly that the presence of moisture has very considerable influence on the union of the two gases.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mr. W. A. Filbert; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. C. A. Rawlins; a Lanner Falcon (*Falco lanarius*) from Egypt, presented by Dixon Bey; a Globose Curassow (*Crax globicera*) from Central America, presented by the Hon. Mrs. Lawly; a Stone Curlew (*Œdicnemus scolopax*) European, presented by Mr. A. W. Arrowsmith; eight Dwarf Chameleons (*Chamaeleon pumilus*) from South Africa, presented by Miss Kay; a Horned Lizard (*Phrynosoma cornutum*) from Mexico, presented by Mr. C. W. Farquharson; seven Viperine Snakes (*Tropidonotus viperinus*) European, presented by the Rev. F. W. Haines; two Smooth-headed Capuchins (*Cebus monachus*) from South-East Brazil, a Macaque Monkey (*Macacus cynomolgus*) from India, six Mountain Witch Ground Doves (*Geotrygon cristata*) from Jamaica, two Changeable Lorikeets (*Ptilosclera versicolor*) from North-West Australia, a Suricate (*Suricata tetradactyla*) from South Africa, deposited; an English Wild Cow (*Bos taurus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN DECEMBER:—

Dec. 1. 6h. 37m. to 10h. 19m. Transit of Jupiter's Sat. III. (Ganymede).
1. 5h. 15m. Minimum of Algol (β Persei).
4. 7h. 38m. to 8h. 33m. Moon occults β Capricorni (mag. 3·4).
5. 7h. Moon in conjunction with Jupiter. Jupiter, 5° 52′ S.
10. 7h. 8m. to 8h. 22m. Moon occults ζ^1 Piscium (mag. 4·2).
10. 20h. Venus in conjunction with Uranus. Venus, 0° 8′ S.
11–12. Epoch of Geminid meteoric shower.
13. 13h. 53m. to 14h. 56m. Moon occults δ^1 Tauri (mag. 4·0).
13. 14h. 27m. to 15h. 23m. Moon occults δ^2 Tauri (mag 4·7).
14. 16h. 52m. to 17h. 0m. Moon occults 120 Tauri (mag. 5·3).
15. Venus. Illuminated portion of disc = 0·998, of Mars = 0·904.
15. 18h. 24m. to 18h. 42m. Moon occults 26 Geminorum (mag. 5·1).
16. 3h. 34m. to 8h. 29m. Transit of Jupiter's Sat. IV. (Callisto).
16. 5h. 49m. to 6h. 32m. Moon occults λ Geminorum (mag. 3·6).
16. 12h. 27m. to 13h. 20m. Moon occults 68 Geminorum (mag. 5·0).
17. 18h. 37m. to 19h. 36m. Moon occults A^2 Cancri (mag. 5·8).
18. 10h. 9m. Minimum of Algol (β Persei).
21. 6h. 58m. Minimum of Algol (β Persei).
21. 15h. 0m. Moon in conjunction with Mars. Mars, 4° 22′ N.
22. 7h. 0m. Sun enters Capricornus. Winter commences.
30. 0h. 6m. to 3h. 49m. Transit of Jupiter's Sat. III. (Ganymede).
31. 5h. 0m. Moon in conjunction with Saturn. Saturn, 5° 20′ S.

EARLY OBSERVATIONS OF NOVA PERSEI.—In *Circular* No. 66 of the Harvard College Observatory, Prof. Pickering details the results which have been obtained from the measurement of the photographs of the region of Nova Persei which were obtained during the years 1890, 1893 and 1894.

These measurements indicate that the star on the Harvard photographs, which was pointed out by Father Zwack, of the Georgetown College Observatory, and also announced by M. S. Blakjo (*Astronomische Nachrichten*, 157, 193), is a variable which for several years has oscillated between the thirteenth and fourteenth magnitudes, and they also lead to the conclusion that it was, for that period, within one or two seconds of arc of the Nova's position, the difference in position being less than the probable errors of measurement.

COMET 1902 *c* (GRIGG).—A communication from Mr. P. Baracchi, director of the Melbourne Observatory, to No. 3828 of the *Astronomische Nachrichten* states that a search was made for this comet on the first available evening after Mr. Grigg's announcement of its discovery, but without success; nor has the comet been found by any of the Australian observatories. This may be accounted for by the prevalence of bright moonlight on the available nights and by the statement of Mr. Grigg that the object was an extremely faint one.

Enclosed with this communication is a list of the observations made by the discoverer. These observations state that the comet, when first seen, appeared as a faint nebula and was about twice the diameter of Jupiter, the atmosphere never being quite clear. Fourteen observations were made between July 23, when the comet was first seen, and August 3, but after the latter date, bad weather and bright moonlight prevented any further observations.

The instrument used was a $3\frac{1}{2}$-inch refractor, and the N.A. clock stars β, γ and δ Virginis, and ν Virginis, were observed as "near" stars, the apparent position of the last named being taken as 11h. 40m. 52s. $+ 7° 4'.5$.

From the observations made on July 24, 27 and 30, Mr. Grigg has computed the following corrected elements:—

$$T = 1902 \text{ June } 20{\cdot}33 \text{ G.M.T.}$$

$$\begin{aligned} \omega &= 301^\circ\ 46'{\cdot}1 \\ \Omega &= 217\ 31{\cdot}4 \\ i &= 16\ 42{\cdot}9 \\ \log q &= 9{\cdot}76618. \end{aligned}$$

The position for August 3 as computed from these elements differs by + 1m. 36s. and + 4′ from the observed position on that date.

The computed position at perihelion was $\alpha = 113° 34'$, $\delta = + 15° 23'$, about 10° north of Procyon, the apparent distance from the sun being 25° E., 6° S. The longitude of the comet from the sun would then increase, and the comet would pass through Cancer towards Regulus until it reached Virgo at the time of its discovery by Mr. Grigg.

APPARENT DEVIATIONS FROM NEWTON'S LAW OF GRAVITATION.—In a paper read at the Göttingen meeting of the Astronomische Gesellschaft on August 4, Herr Peter Lebedew reviewed the various theories which have ever been proposed to account for the apparent contradiction to the law of gravitation as observed in the repulsion of comets' tails from the sun, and he finally accepts the theory of Kepler, which attributes the repulsive force to solar radiation.

The author stated that he had recently confirmed the quantitative relation expressed in the formula for this repulsion, due to Maxwell and Bartoli.

For a spherical body, the diameter of which is great as compared with the wave-lengths of the solar radiation, the resulting action (F) is expressed, in gravitational units, by the formula

$$F = 1 - \frac{1}{10{,}000} \cdot \frac{1}{r\delta}$$

where r is the radius in centimetres and δ is the density of the body as compared with that of water. For dust particles, the diameters of which are comparable with the wave-lengths of the solar radiation, the above relation does not hold good.

This relation explains the varying behaviour of different parts of a comet, for it is obvious that, in a cometary nucleus made up of meteorites of various dimensions and densities, we should expect varying values of F.

TOTAL LIGHT OF ALL THE STARS.—Mr. Gavin J. Burns contributes to No. 3, vol. xvi. of the *Astrophysical Journal* an interesting account of some results he has obtained whilst attempting to estimate the total light of all the stars.

In the first place, he determined the relative brightness of different parts of the sky by observing these different parts through varying thicknesses of ordinary clear glass, and then determining what proportion of the total incident light was transmitted by a unit thickness of glass. He found that the luminosity of the Milky Way varies from two to three times the luminosity of the rest of the sky.

Secondly, he compared the luminosity of the stars with that of the normal sky by the method of putting the star image out of focus until its apparent brightness was equal to that of the surrounding sky; by this process he deduced, from the mean of several independent observations of various stars, that half a square degree of non-Galactic sky gives as much light as a fifth-magnitude star. From further observations, Mr. Burns found that, given a perfectly black background, stars as faint as the eighth magnitude would be readily visible.

WEST INDIAN VOLCANIC ERUPTIONS.

AS a panacea for much ignorance, the subtle fluid of Franklin stands next to superstition. If you cannot explain the angry workings of a volcano by a Pluto, a Vulcan or the strugglings of the damned, tell the man in the street that it is due to electricity and he is happy. At the present moment, in seventeen columns of the *Revue Scientifique* of September 6, M. Arthur Tarquin offers to the world an electrical theory of volcanic action which, to a great extent, is novel. At the outset we are told that the earth is entirely governed by the sun, and as its energy varies so will various activities on the earth vary. In establishing such a connection for volcanic activity, M. Tarquin, however, poses as a special pleader. In Tokio, for example, he says that earthquakes (*sic*) are most numerous about the times when sun-spots are at a maximum and *at a minimum*. Dr. E. Naumann, who examined the earthquake registers of Japan, however, failed to find such a connection, and others who have worked with materials relating to other countries have arrived at similar conclusions. As another example of incompleteness in statement, we are told that at the "*moment précis*" of the eruption in Martinique, with a mathematical exactitude magnetic needles at observatories throughout the world were violently disturbed. Even if we admit this to have been the case, we fail to see why similar phenomena were not observed with the more violent eruption which took place the day previously in St. Vincent.

As solar energy penetrates denser and denser layers of the earth's atmosphere, the same becomes warmer and warmer; why, therefore, asks M. Tarquin, should not the internal heat of the earth be explained by similar reasoning? This heating he apparently regards as the result of an increasing resistance to the passage of electricity. The oceans are regarded as vast accumulators. Electric potential is greater where ocean currents meet with obstacles, as, for example, where the Gulf stream passes the Antilles, and it is, therefore, in such places where volcanic activity is pronounced.

So convinced was M. Tarquin of the truth of his theory that he brought the same to the notice of M. le Ministre des Colonies, but it apparently received but small consideration. An official commission was sent to Martinique, but it neither foretold the eruption of July 9 nor that of August 27. On the contrary, it concurred in the return of the inhabitants to their deserted homes and the establishment of brigades of soldiers at Morne Rouge and other places, whilst the chief of the scientific mission issued in the official journal a letter assuring the inhabitants of safety.

This advice M. Tarquin holds to have been based on classical but false hypotheses respecting the cause of volcanic activity, and the exposition of these views lulled many into a feeling of security which they paid for with their lives. The theory of the "pyrophiles" is dangerous to humanity.

The *Revue Scientifique* of September 13 contains a report by the delegates of the Paris Academie des Sciences on the eruption in Martinique of May 8.

This first refers to a chronological account of the eruptions and various volcanic manifestations before the destruction of St. Pierre, and gives a description of the crater of Mont Pelée. By the eruption many fissures were formed, the existence of which is recognised by lines of steam vents. These continued beneath the sea, and accounted, no doubt, for the interruption of the cables and the numbers of dead fish observed on May 5. From these fumaroles steam and sulphuretted hydrogen escape, and round their orifices crystals of sulphur and sal-ammoniac are found. Their temperature at a depth of 0·10m. is about 400° C. Along the beds of the rivers Blanche and Sèche, and particularly near their mouths, these vents are very vigorous, but they vary in their activity and give rise to variations in the temperature of the water in the rivers.

The cinders which fell at Prêcheur formed a layer about 25 centimetres in thickness. At Carbet lapilli one centimetre in diameter were common. Some fragments were larger, and were

similar to those which fell at Fort de France and François on May 8 and 20. On July 9 the character of the ejectamenta became more pumiceous. Bombs 1·3m. in diameter were projected 800 metres. There does not appear to have been any change in the depth of the ocean near to St. Pierre.

On May 8 at the time of the eruption the sea at Fort de France receded 1m., and there were five or six undulations at intervals of about five minutes. Similar movements were also observed on May 20 and 26, June 6 and July 9. From May 7 to May 10 an unusually strong current was observed on the west coast. Each eruption was accompanied by a barometric oscillation from 1 to 3mm. in amount.

In *McClure's Magazine* for August, and in the *Fortnightly Review* for September, Prof. Angelo Heilprin contributes an article on "Mont Pelée in its Might."

For the first time we are told that for three months before the fatal explosion of May 8 Pelée had been rumbling, and that there had been occasional emissions of steam. The hour at which this explosion took place is fixed by the s.s. *Pouyer Quertier* and by the cable office at Fort de France at 8h. 2m. a.m., but according to the dial of the Hôpital Militaire of St. Pierre the time was 7h. 52m. a.m.

The first explosion would therefore appear to have resulted in ruin the distribution of which was quaquaversal. It might, for instance, have been produced by the explosion of a gas cloud. The latter, which left ruins with a definite orientation, may have had the character of a blast propagated in one direction.

No doubt, Prof. Heilprin concludes, there were numerous electric explosions, unmistakable evidence of which is found in perforated pottery and metal wares.

In the *Popular Science Monthly* for August, Dr. Thomas A. Jaggar gives an account of his visit to Martinique and St. Vincent. His first landing at St. Pierre was on May 21, the day after the second great eruption of Mont Pelée. Masonry had been completely destroyed, there was an absence of large volcanic fragments, and "everything was coated with a green-grey powder or sand." No sign of molten rock was found either here or in St. Vincent. At the latter island La Soufrière was ascended twice, after which Dr. Jaggar proceeded to Barbados to learn something of the dust showers which had covered that island.

At Walliabou and Richmond the same fiery blast swept down from La Soufrière as that which swept down on St. Pierre, and just as St. Pierre is buried so is Richmond buried, the ashes at the northern end of the town being 45 feet in thickness and three feet at the southern end. The masonry in the village was swept over, and 5-foot blocks of the same were blown to distances of 40 feet. On the west sea front of the Soufrière there are now vertical walls of earth in certain places 50 feet in height where before there was a village

M. M. Ballou, in his "Equatorial Africa," writing in 1892, says that "it is confidently predicted (that Mont Pelée) will one day deluge St. Pierre with ashes and lava, repeating the story of Pompeii," a prediction, Dr. Jaggar remarks, based on "well-authenticated data."

Before this last eruption, so far back as January, the lake in the crater at Pelée was warm and the odour of sulphuretted hydrogen was perceived. In April, steam was emitted and rumblings were heard. From April 24 there were actual eruptions.

In St. Vincent, local earthquakes had been on the increase for a year, and so far back as May, 1901, people were frightened away from the north-west slope of the Soufrière by rumblings and quakings. The lake bubbled and sulphurous coatings were found on the rocks. In short, the signals were so pronounced that the leeward slopes of the Soufrière were abandoned, and hence the small loss of life. Had the Governments of both islands maintained vulcanological stations, the records of "tremors, sounds, sights, smells and temperatures" would no doubt have formed an increasing series of warnings.

In the Blue-book (Cd. 1201) we find 144 official communications relating to the volcanic eruptions in St. Vincent and Martinique in May, 1902. These, as may be expected, are varied in their character. Some refer to earthquakes, others to eruptions. Many are requests for assistance, whilst others are expressions of sympathy. In communication No. 129, Mr. Secretary Chamberlain calls the attention of the Board of Trade to the bravery of Captain Freeman and suggests that it should not be allowed to pass without recognition. The reply to this states that the Board has decided to award Captain Freeman a piece of plate in recognition of his gallantry. Other communications deal with the mineralogical character of the ejectamenta, personal experiences within the devastated zone, pecuniary losses and other matters. Although many of the notes in this volume have but a small scientific value, there yet remains much not to be overlooked by those who compile the history of these terrible disasters.

Dates of Volcanic Eruptions in Central America and the West Indies (Rockstroh-Fuchs).

1552	1699	1785—	1852—
1526—	1705—	1797 × —	1853—
1541	1706	1798—	1854—
1565—	1707	1799—	1855—
1581	1709—	1802 × —	1855—
1582—	1710	1803—	1856—
1585 6—	1717—	1809—	1857—
1614	1718 × —	1812 × —	1858—
1623	1723	1821—	1860
1643	1726	1828	1865
1651—	1732—	1829—	1867—
1664	1737—	1833	1868
1668—	1764	1835—	1869—
1670	1766 × —	1836 × —	1870
1671	1770	1844—	1873
1677—	1772	1847—	1880—
1686	1775	1850	1883
1692 × —	1775	1851 × —	1902 : —

West Indian eruptions are marked ×.
Unusual seismic disturbances are marked —.

From the above, which is chiefly compiled from the writings of Rockstroh and Fuchs, it will be noticed that *all* the West Indian eruptions have been accompanied by unusual seismic disturbances either in the West Indies themselves or in neighbouring rock folds.

J. MILNE.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—In consequence of the large number of students in the department of anatomy, it is proposed to appoint two additional demonstrators, to be paid from the fees received for instruction.

The State Medicine Syndicate report that ninety candidates have been examined by them in the present year; of these, fifty-two were successful in obtaining the University diploma in public health. The Syndicate propose that a second grant of 1000*l.* be made from the funds in their hands toward the new Medical School buildings, in which provision will be made for teaching and examinations in sanitary science.

The Sedgwick Memorial Museum of Geology is nearly ready for occupation; the building syndicate estimate the cost for structure and fittings at more than 45,000*l.* Of this, some 27,000*l.* comes from the accumulated subscriptions to the memorial fund, 3000*l.* will be obtained from the University Press profits, and the balance probably from the benefaction fund.

THE Right Hon. Sir William Hart Dyke, Bart., M.P., will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Friday, December 12.

THE *Athenaeum* announces that Sir William Muir has resigned the post of principal of the University of Edinburgh, which he has held since 1885.

IN his inaugural address at the opening of the session of the Royal College of Science, Prof. Perry expressed his anxiety for the creation of a fund to provide bursaries to assist the national scholars and other Government students. We are glad to hear that this fund has been started with a gift of 100*l.* from the Drapers' Company, to be divided equally among ten of the scholars. The Company do not pledge themselves to continue this help.

LOCAL museums and local natural history societies can be of much assistance to nature-study in schools by directing attention to observations of natural objects. We are, therefore, glad to see that there will be a conference on nature-study at the Stepney Borough Museum on December 3, at 5.30 p.m.,

when Mr. A. D. Hall, director of the Rothamsted Agricultural Experiment Station, will give an address. The chief object of the conference is the development of the work of the museum with the schools.

ABOUT six hundred teachers and school managers from all parts of the East Riding met at Beverley on Saturday last, at a conference on nature-study. Lord Herries, chairman of the Technical Education Committee of the East Riding County Council, presided, and an address was given by Prof. Miall, who advised his hearers not to use stuffed animals and dried plants in the class-room, but wherever possible to study living animals and plants. A representative committee was elected to promote nature-study in the East Riding and Hull.

WE learn from the *British Medical Journal* that the Board of Trustees of the Johns Hopkins University, Baltimore, has accepted an offer made by Dr. and Mrs. Christian Herter, of New York, to give 5000*l*. to found a memorial lectureship in the medical department of the University, "designed to promote a more intimate knowledge of the researches of foreign investigators in the realm of medical science." This end is to be secured by inviting each year some eminent worker in physiology or pathology to deliver one or more lectures at the Johns Hopkins University upon a subject with which his name is associated. The lecturer will receive as an honorarium the annual income of the endowment. The selection of the lecturer will be made by a committee consisting of Dr. Welch, Dr. Osler and Dr. Abel.

THE Gordon Memorial College at Khartoum, which Lord Kitchener opened recently, is now ready for the chemical and bacteriological research laboratories presented by Mr. Henry S. Wellcome during his recent visit to the Soudan. The fixtures and appliances, made in England, have already been shipped. The equipment for scientific work is most complete in every detail, and will be equal to that in any similar laboratories in Europe. The Sirdar has appointed as director of these research laboratories Dr. Andrew Balfour, of Edinburgh, who has done good work in bacteriology. The Soudan presents exceptional opportunities for the study of tropical diseases, especially malaria, typhoid and dysentery, and it is anticipated that the results of the investigations of Dr. Balfour and his staff will be of the greatest importance. Apart from the original researches and general sanitary work, Dr. Balfour and his staff will devote their attention to the study of the cereals, textile fibres and various matters affecting the development of the agricultural and mineral resources of the country. Dr. Balfour leaves England on December 11, and will be entertained at dinner at the Princes' Restaurant, Piccadilly, on December 8.

A POST-GRADUATE course for the training of teachers in secondary schools will be commenced in January at the London Day Training College, Clare Market, W.C. Candidates for the one year's course of professional training must be graduates, or must have undergone a course of university study and passed an examination equivalent to that for a university degree in arts or in science. All students will receive instruction in the theory, history and art of education, so as to prepare them for the examination for the teacher's diploma of the University of London, and will also go through a course of practical work in approved secondary schools. All the principles studied in the lecture room will be exemplified in the schools, and visits of observation will be made to schools of marked excellence or of special educational interest. Candidates should make application for admission to the course for graduates not later than December 8. Applications should be addressed to the Secretary of the Technical Education Board of the London County Council, 116 St. Martin's Lane, W.C.

THE report of the Indian Universities Commission, to which attention was directed in these columns on September 4, has given rise to many expressions of dissatisfaction in the native Press of India. A resolution explaining the attitude of the Governor-General in Council towards the report was recently circulated among local governments and administrations with a view to evoke full discussion, so that, before coming to a final conclusion, the Government of India may know exactly what is thought by all persons concerned in Indian education. The resolution makes it quite clear that neither the Government nor the Commission desires to initiate a policy tending to make education the monopoly of the rich. At the same time, it is pointed out that a certain minimum standard of efficiency is necessary, and this is only possible if the expenditure reaches a certain amount which entails fees that some would-be students may find it difficult to pay. The Government, however, contemplates the provision of scholarships for the more able boys and an endowment to cheapen education for poor students. The *Pioneer Mail* is of opinion that the resolution may indefinitely postpone the thorough reform of Indian university education.

ON Monday afternoon, Lord Dudley, in laying the foundation-stone of a new technical institute at Belfast, remarked that if we are to hold our own in the great war of the world, we must see that the soldiers of industry are equipped with the best training that can possibly be given. Replying to the toast of his health at a dinner on Monday evening, Lord Dudley is reported by the *Times* correspondent to have said that the scheme of technical instruction in Belfast was, he understood, incomplete in respect to the fact that it did not include opportunities of learning all that modern science had to tell about the different subjects included in its course. How this defect could be remedied was a subject for careful consideration on their part. The most obvious course would be to make their scheme culminate in the Queen's College and to link that college to their institute. The great obstacle was one of expense; but he could promise them, if they put forward a scheme of that nature, and it was sufficiently supported by local efforts, that the Irish Government would consider it carefully on its merits and bring before the Treasury its claims for assistance from the public funds.

SCIENTIFIC SERIALS.

Journal of Botany, November.—The article by Mr. H. N. Dixon on new varieties of British mosses will interest bryologists. In addition, Mr. E. S. Salmon contributes some bryological notes. The monotypic genus Osculatia instituted by De Notaris is referred to Bryum. and three species of Schwetschkea, C. Müller, are confirmed, while a fourth is assigned to Leskea.—Mr. Spencer Moore describes South African plants, collected mostly by Mr. T. Ommaney and Capt. Barrett-Hamilton, of which several species are new.—The catalogue of British Algæ compiled by Mr. A. E. Batters continues the Rhodophyceæ which began in the last number. —There is presented a brief sketch and portrait of Mr. T. Comber, who made a special study of the Diatomaceæ.

American Journal of Science, November.—Observations on the eruptions of 1902 of La Soufrière, St. Vincent, and Mont Pelée, Martinique, by E. T. Hovey. The first ascent of La Soufrière after the eruption was made on May 7, when the crater was found to be practically unchanged in diameter. The "new" crater of 1812 appears to have taken no part in the eruptions, and although there are many ancient lava beds in the island, no stream of melted lava has issued from the Soufrière during the present eruption. The paper is accompanied by two maps, showing the devastated areas on the two islands, and sixteen photographs.—On the reflection of electric waves at the free end of a parallel wire system, by H. A. Bumstead.—The Upper Permian in Western Texas, by G. H. Girty.—The reduction of vanadic acid by the action of hydrochloric acid, by F. A. Gooch and L. B. Stookey. The reduction of vanadium pentoxide to the trioxide by the action of hot concentrated hydrochloric acid has been suggested as the basis of a quantitative method for the estimation of vanadic acid, but the results of previous work have been contradictory. It is shown by the author that, by the adoption of suitable precautions, the reaction can be made nearly complete, but the method is not a suitable one for the determination of vanadic acid, except when this substance is present in very small amount.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 14.—Prof. S. P. Thompson, president, in the chair.—A paper on the theory of the aluminium anode, by W. W. Taylor and J. K. H. Inglis, was read by Mr. Inglis. Aluminium is very slowly acted upon by dilute sulphuric acid even at moderately high temperatures. With dilute hydrochloric acid, the action is violent, and it is found that if a little hydrochloric acid or soluble chloride be added to dilute sulphuric acid, the action is as violent as with hydrochloric acid

of the same concentration. The object of the present paper is to find an explanation of this anomalous behaviour of sulphuric acid, and of the effect produced by the addition of chloride. It has long been known that, when an aluminium electrode is employed as anode in a solution of a sulphate or sulphuric acid, there is a very great resistance offered to the current, and that this resistance is due to a film which separates the electrode from the solution. If the aluminium is the kathode, or if other acids are substituted for sulphuric acid, this great resistance does not exist. It seems probable that the two phenomena are related, and that the film is also the cause of the slow action of sulphuric acid on aluminium. The authors have attempted to establish a theory which will explain these phenomena. The influence of certain salts of potassium in various concentrations was investigated, and the authors conclude that the presence of certain ions enables a large current to pass through the cell. The reason seems to be that the film of aluminium hydroxide with which the anode is covered is permeable to certain ions but impermeable to others. The anomalous behaviour in sulphuric acid would then be due to the impermeability of the film to the SO_4'' ions and also to the $Al^{\cdots}$ ions. Further experiments gave support to the view that the abnormal behaviour of aluminium anodes in sulphuric acid is due to impermeability.—A paper on a determination of the ratio of the specific heats at constant pressure and at constant volume for air and steam was read by Mr. Mackower. The method employed in this paper is similar to that used by Lummer and Pringsheim, and consists in allowing the gas under investigation to expand adiabatically and measuring the lowering of temperature caused by such expansion. The author's value for the ratio of the two specific heats in the case of air is 1·401. The observations with steam were similar to those in the preceding experiments, but special precautions were necessary to prevent the condensation of the steam in the tubes leading to the vessel. The results for steam were not sufficiently accurate to justify the application of corrections for radiation and for conduction and convection. The values of γ deduced from two series of experiments were 1·307 and 1·304.

Royal Astronomical Society, November 14.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—Dr. Isaac Roberts read a paper on Sir W. Herschel's nebulous regions, compared with photographs of the same regions taken simultaneously with the 20in. reflector and 5in. Cooke lens. The results show that on forty-eight of the areas described by Herschel as nebulous there is no visible trace of diffused nebulosity, while on the remaining four there is nebulosity with very characteristic features. Photographs of these remarkable nebulous regions were thrown on the screen.—Prof. H. H. Turner read a paper on the suggestion made by Sir D. Gill that the brighter stars are, as a whole, rotating with respect to the fainter stars as a whole. A comparison of photographs taken at Oxford between 1892 and 1902 indicated a relative motion of the brighter stars of about the same amount as that found by Sir D. Gill, but in the opposite direction. Prof. Turner made the suggestion that the stars nearest to the sun may be, generally speaking, intrinsically fainter than those of the Milky Way, and there would thus for some regions be a discontinuity in the law by which fainter stars are, as a whole, more distant than brighter stars.—The secretary read a paper on the same subject communicated by the Astronomer Royal. A comparison has been made between Groombridge's catalogue (1810) and the Greenwich second ten-year catalogue (1890). The results, so far obtained, could not be taken as affording evidence of the cosmical movement suggested by Sir D. Gill.—Mr. E. T. Whittaker read a paper on the general solution of Laplace's equation and of the differential equation of wave-motions, and on an undulatory explanation of gravitation. The principal result was the general solution, by means of a definite integral, of the well-known partial differential equation which is satisfied by all Newtonian potential functions. It was then shown that a definite integral of a similar type furnished the general solution of the partial differential equation which occurs in the theories of light, sound and electromagnetic waves. From relations between the two solutions thus obtained, it was shown that any disturbance which can be represented by a solution of Laplace's equation can be compounded from simple uniform undulatory disturbances, and it was suggested that this analysis might furnish the explanation of the propagation of gravity.—Photographs of Perrine's Comet, taken at Greenwich, &c., were shown on the screen. On one of the Greenwich photographs, no less than seven tails were shown, one of them a degree in length.—A paper by Dr. Max Wolf on stereoscopic pictures of Perrine's Comet was read, and the photographs exhibited.—The secretary read papers by Mr. Percival Lowell on an expedition to determine the best situation for an observatory and on a proposed standard scale of "seeing."—Mr. H. C. Plummer gave a short account of his second paper on the images formed by a parabolic mirror.—Other papers were taken as read.

Geological Society, November 5.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The secretary read a communication, transmitted by the Rt. Hon. the Secretary of State for the Colonies, from Mr. H. Powell, Curator, Botanic Station, St. Vincent, to Dr. D. Morris, C.M.G., Imperial Commissioner of Agriculture for the West Indies, referring to the eruption of the Soufrière on September 3 and 4. At 3 p.m. on September 3, the corrected barometrical reading was 29·947, and the attached thermometer 85° F. Mr. Powell was informed that during the day a lot of matter was ejected over the western lip of the old crater down the Laricor or Roseau Valley to the sea. At 9.55 p.m., as seen at the Botanic Station, the eruption commenced in earnest; flashes of flame and lightning were visible over the Soufrière at intervals of twenty to thirty seconds, with frequent longer intervals. At 10.30 p.m., the corrected reading of the mercurial barometer was 30·105 and the attached thermometer 81°·5 F. From about this hour, the discharges and accompanying noises increased in frequency and severity, and at 1.30 a.m. (September 4) the Soufrière was in full eruption. From this hour to 2 a.m., the eruption was more severe than on May 7, the explosions seeming to be louder and more continuous, and the electric discharges, owing, doubtless, to its being night, immeasurably grander and more awe-inspiring. At 2 a.m., the corrected barometrical reading was 30·045 and the temperature 81° F., and at 3 a.m. the corrected reading was 30·035. The marvellous electric display was checked by a heavy shower from the east, and the roar was correspondingly lessened. From about 1.30 a.m., a cloud black as gunpowder was seen advancing southward from the Soufrière, and at 2.30 this cloud had assumed a circular form and was overhead of the Botanic Station. The discharges from this cloud and to northward were exceedingly numerous and severe, and the appearance generally was as though myriads of long, fiery serpents were darting hither and thither, and a constant crackling noise was heard, in addition to the roar of the volcano. The chief disturbances seemed to be west of the Soufrière, in the direction of Martinique; and the writer is strongly of opinion, from observations at the time, that Mont Pelée and the Soufrière were in action together, but so far no news has come from Martinique. At 3 a.m. (September 4), the discharges and roar to the west nearly subsided, and the Soufrière alone seemed in action, but more on the windward side. From 3 to 4 a.m., the eruption gradually slackened, and at the latter hour had nearly ceased. The next morning, the barometer was normal at 29·950.—A second communication (also received through the Secretary of State for the Colonies) was read, dated Grenada, September 23, from Sir R. B. Llewelyn, Governor of the Windward Islands, expressing the hope that some scientific observers might be induced to go out to the West Indies and settle there for some time, in order to accumulate information as to volcanic and kindred phenomena.—The fossil flora of the Cumberland coalfield, and the palæobotanical evidence with regard to the age of the beds, by Mr. E. A. Newell Arber. The succession of Upper Carboniferous rocks in the region in question is apparently twofold—an arenaceous series, 600 feet thick, consisting of massive sandstones alternating with shales and fireclays, overlying argillaceous and carbonaceous deposits, the latter forming the productive portion of the coalfield and containing three great coal-seams, traceable throughout the district. The Upper or Sandstone series has yielded very few plant-remains from its upper division, but from the lower division a long list of plants is given. A consideration of the palæobotanical evidence has led to a reclassification of the rocks.—Some remarks upon Mr. E. A. Newell Arber's communication: on the Clarke collection of fossil plants from New South Wales, by Dr. F. Kurtz. Agreement was expressed with Mr. Arber's identification of *Rhiptozamites Goepperti*, which was taken to be a synonym of *Noeggerathiopsis Hislopi*. *Podozamites elongatus*, however, was regarded as different from *Noeggerathiopsis Hislopi*. It was not considered that there is sufficient evidence to warrant the separation of *Otopteris ovata* from *Rhacopteris inaequilatera*, in which species it may be retained, perhaps as a variety. *Rh. inaequilatera*

has been found in the Argentine, and has been described by Geinitz as *Otopteris argentina*.—On a new boring at Caythorpe (Lincolnshire), by Mr. Henry Preston. This boring, after piercing Northampton Sands, passed through 199 feet of Upper Lias, 19 feet of Marlstone, and into the Middle Liassic Clays. With the aid of other shallow wells in the Lincolnshire Limestone, this rock is shown to have a decided dip to the west down the face of the escarpment, as though it had settled down upon the eroded surface of the Upper Liassic Clay. This settlement is probably the cause of a continuous spring flowing from the junction, and it has given rise to an underestimate of the thickness of the Upper Lias.

Linnean Society, November 6.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. H. J. Elwes, F.R.S., gave a lecture, illustrated by a specially prepared map and lantern slides, entitled "Notes of a Natural History Journey in Chile," which he performed in the winter of 1901-02, spending five months on the trip. The lecturer confined his remarks to the country which has only recently become accessible, between Mulchen and Puerto Montt. From Buenos Ayres to Santiago is a three days' railway journey, broken by the Andine pass between Puente del Inca and Salto de Soldado, which has to be performed on mules. It was evident that the forests which cover the mountains and extend into the plain had never clothed the outer valleys, though a six hours' ride into the mountains will bring the traveller to abundant groves of the Chilian "cypress," *Libocedrus chilensis*. The most striking plant is *Puya coerulea*. The lecturer visited the beautiful gardens of the late Madame Cousino at Lota; on the hill-sides, large plantations of the Californian *Pinus insignis* are rapidly changing the aspect of the country. Nothing is more striking in the central valley of Chile tranversed by the railway than the wonderful growth of introduced trees, which oust the natives. Lombardy poplars form avenues along the country roads; European oaks, thistles and introduced conifers give the aspect of Italy rather than of South America. This region may rival California as a fruit-producing country. The Agricultural College at Santiago is excellently found, its equipment surpassing anything in England. The lecturer visited the Baths of Chillan, at an elevation of about 6000 feet, where many plants and insects were collected; here the beech forests clothe the mountains, and here also a considerable quantity of the curious orchid Chloræa was obtained with some difficulty. The long fleshy roots were deeply buried in sand and stones amid the bushes and bamboo, *Chusquea andina*; those plants sent to Kew from Concepcion are growing fairly well. At Lolco, a farm on the Bio-bio river, may alpine plants were found. From Los Arcos past Lago Alumine to the Quillen river, few birds were noted, and mammals were very scarce. The extraordinary configuration of the rocks was mentioned. Early in February, the weather broke and several wet days ensued. San Martin is described as very beautifully situated, and will probably hereafter be much resorted to by visitors. The edge of the great Patagonian pampa was reached where the river Limay issues from the Nahuel-Huapi lake; from Puerto Blest to Puerto Montt, an easy track is now available, past the shores of Lago Frio, where *Fitzroya patagonica* was noted; from this lake, a magnificent view of Tronador volcano was obtained, the glaciers of which on the west side descend to about 2000 feet near Casapanque; avalanches were constantly falling from the mountain's precipices, with a noise which gave rise to its name. Here were beech trees, and a growth of *Gunnera chilensis* on the débris brought by the glacier, which was found to be of extreme interest. Lago Todos Santos is buried in forest.

MANCHESTER.

Literary and Philosophical Society, November 18.—Mr. Charles Bailey, president, in the chair.—A paper by Mr. Lionel Adams on a contribution to our knowledge of the mole (*Talpa Europaea*) was communicated by Mr. W. E. Hoyle. The writer, who has been studying the mole for the last four years in the neighbourhood of Stafford, called attention to the singular neglect of this interesting species by naturalists since the time of Le Court (the well-known scientific mole catcher) and Geoffroy Saint-Hilaire at the beginning of the last century, the statements of these observers having been accepted by subsequent writers—with trifling exceptions—without any attempt at verification. The mole has been credited with making its "fortress" on a uniform plan, with exactly the same number of galleries and runs communicating with the nest in precisely the same way, but the writer pointed out that, though he had dissected more than 300 fortresses, he had never found two alike or a single one corresponding to the time-honoured figure in the text-books. His observations showed that the tunnels in the interior of the fortress are not contrived as a means of escape from enemies, but are merely formed incidentally in the process of excavation and in piling up the superincumbent mound. There is, however, one exception to this, viz. the "boltrun," which is a tunnel leading out of the bottom of the nest. The conclusion was also arrived at that, though the mole is not actually blind, its power of vision is extremely limited and it finds its prey by scent alone. Instances were given of the mole eating the eggs of pheasants and partridges, after having undermined the nests, a fact which had hitherto escaped notice.—Mr. F. F. Laidlaw read a paper on some new species of marine planarians from Torres Strait and the Pacific.

PARIS.

Academy of Sciences, November 17.—M. Albert Gaudry in the chair.—On the impurities in compressed oxygen, and on their effect on combustions carried out in the calorimetric bomb, by M. Berthelot. Commercial compressed oxygen appears to be made in three ways, from barium peroxide, peroxide of manganese together with an alkaline hydrate and by the electrolysis of water. Samples of gas prepared in these three ways were examined for oxides of carbon, hydrogen and hydrocarbons, with the result that the amounts of these impurities were found to be too small to have any effect on the use of the gas for calorimetric determinations, and even when used for the estimation of carbon and hydrogen no error is introduced except in the case of the oxygen prepared electrolytically, when an appreciable amount of hydrogen may be present for which a correction is necessary.—On the recent publications of the Observatory of Paris: "Stellar Catalogue," part iv.; "Photographic Catalogue," vol. i.; *Annales*, Observations of 1898; *Memoires* (23); and *Bulletin* of the International Committee (3), by M. Lœwy.—On the determination of the exact position of a mercury meniscus illuminated by a bundle of horizontal rays, by M. G. Lippmann. The difficulties of determining the exact position of a mercury surface are well known, and various devices have been suggested for overcoming them. The method suggested by the author is to illuminate the surface of the mercury by a bundle of horizontal light rays, formed by a collimator placed approximately in a line with the reading telescope. The outline of the mercury meniscus is then seen as a perfectly sharp line, and good observations can be made with a microscope furnished with a micrometer eyepiece. The extreme variation of a set of ten observations carried out in this way was 0·005 mm., with a mean error of about 0·0025 mm.—A simplification of Foucault's pendulum, by M. d'Arsonval. The form described was designed by M. Cannivel, and is noteworthy for its simplicity and cheapness.—The localisation of normal arsenic in some organs of animals and plants, by M. Armand Gautier. The author has applied the methods previously described by him to the examination of the feathers of birds, some marine and freshwater algæ, coal, sea-water and rocks. The conclusion is drawn that arsenic appears to be as widely spread as nitrogen and phosphorus. It is invariably found, although in small proportion, in primitive rocks, soil, sea-water, plants, especially in algæ, and in terrestrial and marine animals. In the latter, it is especially localised in those organs of ectodermic origin which are concerned with sensation and reproduction.—On the specific differences between the two diseases *Nagana* and *Mal de Caderas*, by MM. A. Laveran and F. Mesnil. These two diseases have many points of resemblance, but on close examination prove to be two specifically distinct diseases.—Effect of the excision of the madreporite in starfish, by M. V. Delage.—On the law of pressures in cannon, by M. E. Vallier.—On the analogy between the X-rays and the Hertzian oscillations, by M. P. Duhem.—On the recent sunset glows at Bordeaux, by M. E. Esclangon. The facts observed do not fit in with the hypothesis of cosmic dust either of terrestrial or extra-terrestrial origin. The effects produced can be better explained by the assumption of the production of finely divided ice particles in the upper regions of the atmosphere; the sudden disappearance of the phenomenon was found to correspond with a sudden rise of temperature.—On the approximate representation of functions, by M. W. Stekloff.—On the structure of finite groups, by M. E. Cartan.—On bipolar electrodes, by MM. Andre Brochet and C. L.

Barillet.—On the time constant characteristic of the disappearance of the radio-activity induced by radium in a closed space, by M. P. Curie.—On atmospheric hydrogen, by M. A. Leduc. Confirmation of the view recently expressed by Lord Rayleigh that the actual amount of hydrogen free in the atmosphere is only about one-sixth to one-eighth that given by M. Gautier.—On the oxalomolybdites, by M. Bailhache.—Some remarks on musculamine, a base derived from muscles, by M. S. Posternak. The base recently described by MM Étard and Vila, and which they isolated from the products of hydrolysis of the muscle of veal, appears from its properties and analysis to be identical with cadaverine, pentamethylenediamine, and hence is not a triamine as supposed by MM. Etard and Vila. It would, however appear to be the first example of the direct formation of cadaverine by the hydrolysis of an albuminoid by means of acids.—On the variation in the reserve hydrocarbons in the stem and root of ligneous plants, by M. Leclerc du Sablon.—*Landolphia Pierrei* considered as a source of caoutchouc, by M. Henri Hua.—The influence of organic materials on the development and anatomical structure of some phanerogams, by M. Jules Laurent. The author has shown in previous publications that certain organic materials, such as glucose, saccharose and inert sugar, form excellent food substances for green plants. These results are now extended to glycerol and humic acid.—The analogy between the Carpathians and the Alps, by M. Maurice Lugeon.—The electrolysis of metallic salts in the tissues, by M. André Poëy.—An apparatus for determining the duration of luminous impressions on the retina, by M. Maurice Dupont. The apparatus described has been applied to the determination of the duration of the persistence of images on the retina, under normal conditions and in pathological cases.—The production of sleep and of general anæsthesia by electric currents, by M. S. Leduc. The production of sleep and of general anæsthesia in animals by means of electric currents has been described in a previous paper, but the method gave rise to some pain at the commencement; by introducing into the circuit a rheostat without self-induction, and taking from three to five minutes to attain the full intensity of the current, these inconveniences can be removed.—The reproduction of an unlimited number of phonograms in wax for phonographic museums, by M. L. Azoulay.—The production of fixed colours on all kinds of leather by the use of salts of molybdenum combined with tanning materials, by M. Emm. Pozzi-Escot.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 27.

ROYAL SOCIETY, at 4.30.—Experiments on the Effect of Mineral Starvation on the Parasitism of the Uredine Fungus *Puccinia dispersa* on Species of Bromus: Prof. H. M. Ward, F.R.S.—Note upon Descending Intrinsic Spinal Tracts in the Mammalian Cord: Prof. C. S. Sherrington, F.R.S., and Dr. E. E. Laslett.—The Inter-relationship of Variola and Vaccinia: Dr. S. Monckton Copeman.—The Colour-Physiology of Higher Crustacea: F. Keeble and Dr. F. W. Gamble.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On Electrons: Sir Oliver Lodge, F.R.S.

FRIDAY, NOVEMBER 28.

PHYSICAL SOCIETY, at 5.—A Slide-Rule for Powers of Numbers: Prof. J. Perry, F.R.S.—A Lecture Experiment to determine the Value of the Mechanical Equivalent of Heat: Prof. Callendar, F.R.S.—A Portable Capillary Electrometer: S. W. J. Smith.

MONDAY, DECEMBER 1.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Influence of Impurities on the Specific Gravity of Sulphuric Acid: Arthur Marshall.—The Interaction of Sulphurous and Nitrous Acids as affecting various Absorbents employed in Testing the Gases escaping from Vitriol Chambers: R. Forbes Carpenter and J. E. Linder.—Note on the Determination of the Strength of Sulphuric Acid: Arthur Marshall.

VICTORIA INSTITUTE, at 4.30.—The Babylonian Story of the Creation: Dr. T. G. Pinches.

SOCIETY OF ARTS, at 8.—The Future of Coal Gas and Allied Illuminants: Prof. Vivian B. Lewes.

TUESDAY, DECEMBER 2.

INSTITUTION OF CIVIL ENGINEERS, at 8.—High-Speed Electrical Generating Plant: T. H. Minshall.

ZOOLOGICAL SOCIETY, at 8.30.—Features of Animal Life in Southern Mexico: Dr. Hans Gadow, F.R.S.—On the Variation of the Elk: Dr. Einar Lönnberg.—On the Crustacea collected during the "Skeat Expedition" to the Malay Peninsula. Part II.: W. F. Lanchester.

WEDNESDAY, DECEMBER 3.

SOCIETY OF ARTS, at 8.—Some Aspects of Photographic Development: Alfred Watkins.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.

GEOLOGICAL SOCIETY, at 8.—On some Suffolk Well-Sections: W. Whitaker, F.R.S.—The Cellular Magnesian Limestone of Durham: George Abbott.

THURSDAY, DECEMBER 4.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—(1) On the "Blaze-Currents" of the Incubated Hen's Egg; On the "Blaze-Currents" of the Crystalline Lens: Dr. A. D. Waller, F.R.S.—A Contribution to the Question of "Blaze-Currents": Dr. A. Durig.—On the Similarity of the Short Period Variation over Large Areas: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—Isomeric Change in Benzene Derivatives. The Interchange of Halogen and Hydroxyl in Benzenediazonium Hydroxides: Dr. K. Orton.—On the Vibrations and Stability of a Gravitating Planet: J. H. Jeans.

LINNEAN SOCIETY, at 8.—New and rare Corals from Funafuti: G. C. Bourne.—On the Morphology of the Flowers and Fruits of the Xylosteum Section of Lonicera: E. A. Newell Arber.—Note on *Carex Tolmiei*, Boott: B. Clarke, F.R.S.—New and old Phalangidæ from the Indian Peninsula: C. With.

RÖNTGEN SOCIETY, at 8.30.—An Observation bearing upon the Therapeutic Action of the Focus Tube: Dr. D. Walsh.—X-Rays in Ophthalmic Work: Stephen Mayou.—Mr. Isenthal will show the Nodon Electric Valve for converting Alternating into Continuous Current.

CHEMICAL SOCIETY, at 8.—The Absorption Spectra of Metallic Nitrates. Part II.: W. N. Hartley.—The Specific Heats of Liquids: H. Crompton.—(1) Studies in the Camphane Series. Part X. The Constitution of Enolic Benzoylcamphor; (2) Note on the Isomeric Benzoyl Derivatives from Isonitrosocamphor: M. O. Forster.—The Constitution of the Products of Nitration of Meta-acetoluidide: J. B. Cohen and H. D. Dakin.

AERONAUTICAL SOCIETY, at 8.—Presidential Address. Recent Aëronautical Progress: Major B. F. S. Baden-Powell.—The Contributions of Balloon Investigations to Meteorology: Dr. W. N. Shaw, F.R.S.—The Kite Equipment of the Scottish National Antarctic Expedition: John Anderson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Extra Meeting for the Inaugural Address by the President, Mr. J. Swinburne.

FRIDAY, DECEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Erection of Steel Bridges, Sheffield Extension of the London and North-Western Railway: A. Reynolds.

CONTENTS.

THURSDAY, DECEMBER 4, 1902.

DR. NANSEN'S OCEANOGRAPHY OF THE NORTH POLAR BASIN.

The Norwegian North Polar Expedition, 1893-1896, *Scientific Results*. Edited by Fridtjof Nansen. Vol. iii. Published by the Fridtjof Nansen Fund for the Advancement of Science. Pp. xii + 428; 88 Plates. (London: Longmans, Green and Co., 1902.)

THIS volume discusses at great length the not very numerous observations on the physical conditions of the water in the Arctic Sea which were made on board the *Fram* during her memorable drift. The matter is dealt with in two memoirs, both by Dr. Nansen, the first on the oceanography of the North Polar Basin, the second on hydrometers and the surface tension of liquids. The second memoir may be considered as an appendix to the first, a great part of which also deals with methods and discusses experiments carried out after the return of the expedition.

We must, in the first place, express gratitude to Dr. Nansen for his choice of the English language as the medium by which the official account of his expedition is made public; a choice which brings at least this reward, that his volumes will find their natural place beside the magnificent record of the *Challenger* expedition.

It is natural to look at the contents of this volume from the separate points of view of methods and results. As to methods, it must be confessed that the key-note is one of regret mingled with hope. "What might have been" if the experience gained during the voyage had been available before it started is insisted upon almost too much; and we are sometimes tempted to forget, in dealing with the results, that the high degree of possible precision lay latent in the methods and was not actually attained. Dr. Nansen, indeed, loses no opportunity of disclaiming higher accuracy than his instruments as they were handled could give, and we have rarely seen a scientific man more candid in blaming himself for neglecting precautions which, after all, few specialists in his subject, if any, thought necessary at the time of his departure.

The methods most fully dealt with are those of determining the temperature and density of sea-water at various depths. Two methods of observing the temperature were usually used, one involving the use of the Pettersson insulating water-bottle and the other the reversing thermometer on Negretti and Zambra's principle. The insulating water-bottle is an apparatus which encloses at a given depth a large sample of water, partly in a central tube, partly between the members of a series of concentric outer tubes having no communication between them. It is thus apparent that before the temperature in the inner tube can change, the temperature of each of the concentric water-jackets must be changed to a greater degree. The important question is how long a time may be allowed to elapse before the temperature in the inner tube changes by an amount appreciable on the thermometer. The actual water-bottle used on the voyage was lost, and its constants could not be tested. Two other water-bottles of apparently identical construction gave on examination distinctly different results, and differences were also found when the external temperature was changed in various ways. It seems probable, however, that with one of the improved water-bottles on this principle, the constants of which have been elaborately determined before use, it may be possible to arrive at temperature readings to something approaching the hundredth of a centigrade degree; but this will be the result of applying many corrections, some of considerable magnitude. The question is not definitely settled, but it is clear at least that no error exceeding one-tenth of a centigrade degree should occur with a water-bottle of this description when skilfully handled. The peculiar virtues and failings of the Negretti and Zambra reversing thermometer are familiar to all who have had occasion to use that beautiful but capricious instrument for deep-sea work. Dr. Nansen discusses the various corrections which have to be applied, and in their case also he suggests improvements which should lead to increased precision and certainty. For the *Fram* expedition, the reversing thermometers gave readings the error of which in almost all cases could be guaranteed not to exceed $\pm 0^{\circ}\cdot 1$ C.

The determination of density received a great deal of attention, for just as Dr. Nansen believes that observations of sea-temperature should be correct to one-hundredth of a centigrade degree, so he believes that the density of sea-water should be obtained with a degree of precision sufficient to indicate a difference as small as one unit in the fifth place of decimals, when the density of distilled water is taken as unity. But in the case of density, as in that of temperature, the results of the *Fram* did not realise the desired ideal. The investigation as to why this was so occupied much time and led to the interesting study in hydrometry which forms the second paper. We cannot follow the experiments in detail, and it must suffice to say that the villain of the piece was finally exposed and found to be grease. Variations in surface tension due to observing with unwashed hands or wiping the hydrometer with a towel not above reproach led to the most distressing irregularities. It was shown that an ordinary stem-reading hydrometer could give good results if the glass was perfectly clean and the surface of the water swept free from impurities by careful brushing with a piece of clean paper. But better results can be obtained by using hydrometers of total immersion, which act in the heart of the liquid untroubled by surface tension or capillarity. Dr. Nansen finds the best results when using a jar with vacuum jacket on the principle employed by Prof. Dewar for handling liquid air, thus preventing change of temperature by radiation. The stemless hydrometer is weighted so as just to float in the sample of sea-water the temperature of which is read by means of a very sensitive thermometer. The temperature is then raised by stirring with a tube containing warm water, and the exact temperature at which the hydrometer begins to sink is noted; a tube of cold water is then used as a stirring rod until the hydrometer begins to rise again, and thus by one or two operations the temperature at which the sample has the precise density of the weighted hydrometer can be ascertained with high precision. Other methods of determining salinity were tried on board, the

refractometer and an apparatus for measuring electrical resistance having been experimented with. Both gave fair results, but were troublesome and consequently not much used. The electrical method required the use of a standard solution of potassium chloride the resistance of which was balanced against that of the sample by means of a slide-wire Wheatstone's bridge, a telephone being used instead of a galvanometer. In the long run, the indications of the stem-reading hydrometers had to be relied on for the tables of specific gravity and salinity published in the memoir.

Samples of sea-water were brought back for chemical analysis, but they were not numerous enough to enable any definite conclusions to be drawn. So far as they went, they showed great similarity between the chemical composition of the salts in Arctic Sea water and in average ocean water, the freezing of the surface appearing to exercise very little selective action on the dissolved salts.

The observations of temperature and density are printed in full with critical remarks, and the data are utilised to throw light on the circulation of the water in the North Polar Basin, the results of other expeditions being considered simultaneously, so far as they affect the region under discussion. Dr. Nansen endeavours to arrive at the circulation of water in the sea by calculating the density *in situ* and representing this on maps and sections by isopyknals, which bear the same relation to the circulation of the sea that isobars do to the circulation of the air, and by isosteres or lines of equal specific volume. The flow of water is deviated from the direction of the density gradient, both for horizontal and vertical movement, by the rotation of the earth, and the amount of this deviation being calculated, it is possible to estimate the circulatory force of the sea due to differences of density alone, supposing that there was no wind. But the wind, acting on the surface water or even on the ice, probably has a greater influence on the movement of the water than the isopyknal gradient; hence a large part of the discussion is occupied by the consideration of the wind-drift and its rotational deviation. It is quite impossible in the limited space of a review to enter critically into the methods by which Dr. Nansen arrives at his conclusions; indeed, the only criticism we are prepared to make is that he has perhaps given too much detail, erring towards diffuseness rather than towards conciseness. However, we can give no more concise statement of the general conclusion as to the Arctic Sea than in Dr. Nansen's own words:—

"We have thus, in our discussion of the distribution of salinity and temperature in the North Polar Basin, arrived at the conclusion that there are at least four systems of currents in a vertical section from the surface to the bottom, along the route of the *Fram*, viz.,

"(1) A surface current of water with low salinity (from about 29 per mille to 32 per mille), perhaps 20m. or 30m. deep, running towards the north-west and west;

"(2) An underlying, slow current of water with a lighter salinity and a very low temperature, running in a different direction, and consisting of surface water from other parts of the Polar Sea. The absolute minimum of temperature is situated in this current, at about 50m. or 60m.;

"(3) A current of relatively warm water with salinities of from 35·1 per mille to 35·3 per mille, coming from the Gulf Stream west of Spitzbergen, and running towards the east at depths below 250m., the maximum of temperature being situated in the water of this current at depths of from 350m. to 450m.; and

"(4) An extremely slow current of colder water, filling the deepest part of the basin between 900m. or 1000m. and the bottom. This water is the heaviest water of the preceding current, which has been cooled down and has sunk towards the bottom; it has a salinity of about 35·29 per mille. It is possible that this water forms to some extent a spiral current under the preceding current, running in a similar direction."

The relation between the water of the North Polar Basin and that of the Norwegian Sea requires additional observations before it can be fully explained, and at every step of the discussion new questions are raised which future investigations must settle.

The fresh surface layer of water in the Arctic Sea is attributed by Dr. Nansen mainly to the inflow from the great rivers of Siberia. In the mass of very slightly warmer water filling the vast hollow of the central Arctic Sea below the zone of maximum temperature, there is unundoubtedly a small but distinct rise of temperature towards the bottom, and this is attributed to the influence of the internal heat of the earth.

We feel that it has been possible to give only an inadequate idea of the value and originality of this great contribution to oceanography, and we have laid stress rather on the methods than the results, because it is by the experience gained in arriving at these methods that Dr. Nansen, as Director of the International Marine Laboratory, will be able to make the physical work of the International Council for the Study of the Sea fuller and more accurate than any similar oceanographical investigation that has gone before it.

H. R. M.

ANIMAL HISTOLOGY.

Lehrbuch der vergleichenden Histologie der Tiere. By Dr. Karl Camillo Schneider. Pp. xiv+988. (Jena: Gustav Fischer, 1902.) Price 24 marks.

WE have only one serious fault to find with this book and it reflects no discredit on the author. That any book should be issued to the public in such a form that the mere operation of cutting the leaves—to say nothing of perusing the pages—involves its falling to pieces can only be characterised as a grave fault, although it is common in scientific books which are "made in Germany." Another fault usual in books hailing from the same quarter, and against which we have frequently protested, is absent in this one, for it contains an index, although not a very complete or well-arranged index. For example, we find "mehrreihiges Epithel," "mehrschichtiges Epithel," indexed, not with "Epithel" the substantive, but in the alphabetical situation of the adjective, where no one would think of looking for them. The art and science of index making has not, it must be confessed, up to the present made much progress in Germany, a fact the more remarkable since it is the country which beyond all others is a producer of books imperatively demanding efficient indices.

For the work itself as a text-book of comparative histology we have nothing but praise. The letterpress

is well written and well printed, and the illustrations are numerous and accurate, and are also beautifully reproduced. By far the majority are original, although the author has, not unwisely, availed himself of good figures by other workers, especially in the domain of vertebrate histology, which has hitherto been more completely exploited than that of Invertebrata. Such a book as this fills an important hiatus in our series of text-books, and it is to be hoped that before long we shall see an English translation. It is certainly strange, considering the importance of the subject and the necessity that so many workers must have felt to be informed regarding what is known as to the minute structure of the tissues and organs in this or that class of animals, that no effort has been made, since the work of Leydig, which was published as long ago as the middle of the last century, to furnish, on modern lines, such an account of minute structure as is ably given by Dr. Schneider in this volume. Oppel's "Vergleichende Histologie" deals, it is true, with a part of the subject, but in a different manner, giving an account, more or less historical and bibliographical, of researches which have been made into the structure of particular organs and groups of organs in Vertebrata, with occasional original observations interspered; while in the book before us we find a description of structure founded mainly on the author's own observations on certain types in each class of the animal kingdom, and merely supplemented by occasional references to the work of other authors. Both methods have their value. That of Oppel tends to produce a book which is a veritable storehouse of information on the more limited subject with which it deals, but it suffers from the disadvantage that such a work must necessarily be enormously bulky and proportionately slow in coming to completion, and as a matter of fact Oppel's book, two or three volumes of which have already been noticed in NATURE, is not only very far from that stage, but it would almost appear—from the present rate of progress—that the end would never be reached at all; whereas in the work before us we have an account of the minute structure of all classes of animals which is, so far as it goes, complete, and is not unduly large considering the vast extent of the subject.

As a matter of fact, Dr. Schneider's work is compounded of three distinct parts, each of which might very well have been published as a separate book. The first of these—under the terms "Cytology" and "Organology"—comprehends an account of the structure of the tissues and organs of animals in general, the resemblances and differences being duly noted; it is, in fact, a general minute anatomy of the animal kingdom. The third or special part, which occupies by far the largest bulk, is also purely histological, but the minute structure is dealt with class by class, beginning with Porifera and ending with Vertebrata. There is in this some unavoidable repetition of the matter contained in the first part. On the other hand, the second part—which is termed "Architektonik"—is not histological at all, but morphological. It deals with the forms of Metazoa and their mode of production, and also includes the consideration of their classification, and such questions as the formation of species and the causes of variation. All this might very well have been omitted in a work dealing with histology—that is to say, a knowledge of the subject might very well have been assumed—in which case the bulk of the volume would have been reduced to more manageable proportions. Moreover, it could have been further reduced by a great diminution of the bibliography, which, although extensive, merely amounts to a collection of titles, for the papers given in it are not specifically referred to in the text. The value of such a list is not apparent, since at best it is sure to be incomplete and could, in fact, be readily compiled more efficiently from well-known publications accessible to everyone. It will appeal to authors who do not take the trouble to search out their own references or to verify them for themselves, but adds no real scientific value to a work of this sort unless the papers quoted have a direct bearing on points treated in the book itself. There are always to be found in the compilation of such lists sins both of omission and of commission—papers of a trivial and unimportant character included, and others of considerable importance omitted altogether. A bibliography, to be of actual value to the readers of a book, must not only have a general relationship to the subject-matter of the work, but a direct specific relationship to the detailed statements and conclusions of the author. As examples of what bibliographies in works on morphology should be like, those given in Balfour's "Comparative Embryology" and in Minot's "Human Embryology" may be instanced. With such as these, which add a definite value to the works which they complete, a bibliography like that in the work under review, even although it contains 36 pages of titles, contrasts unfavourably. In most other respects, Dr. Schneider's book is to be commended as a creditable attempt to supply a want which has been long felt, but which, no doubt, the magnitude of the task has hitherto deterred others from embarking upon.

It should, however, be stated that the author's method is dogmatic rather than critical, and that in disputed and controversial questions he gives the views of the Vienna school of histologists, to which he himself belongs, without, as a rule, so much as hinting that other views are held. If this is a fault, it is one which can be easily forgiven to the author of a text-book, for at least it tends to prevent a confusion of ideas on the part of the learner, to diminish the bulk of the work, and generally to present its contents in a more readable form, and one more useful to the average student.

PHILOSOPHY AND SCIENCE.

The World and the Individual. First Series: The Four Historical Conceptions of Being. By Josiah Royce, Ph.D. Pp. xvi + 588. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1900.) Price 12*s.* 6*d.* net.

The World and the Individual. Second Series: Nature, Man, and the Moral Order. By Josiah Royce, Ph.D. Pp. xvii + 480. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1901.) Price 12*s.* 6*d.* net.

IN the first series of these remarkable Gifford lectures, Prof. Royce gives us the broad outlines of an ontology which serves as the philosophical basis for the special discussion of cosmological and ethical problems contained

in his second volume. As a contribution to the investigation of ultimate metaphysical issues, Prof. Royce's first volume, like previous works by the same writer, deserves high commendation for the frequent grace of its style and the freshness and freedom from unnecessary technicalities with which the problems are presented to the reader. Metaphysics has a bad name with the cultivated public in general on the score of aridity and unintelligibility, but there is nothing in Prof. Royce's lectures that a thoughtful man of ordinary education should find unduly difficult or repellent, and there is much that every such man must find of the highest importance. Writing from a standpoint which may roughly be described as that of Hegelian idealism, but in entire freedom from mechanical adhesion to a master, and often with marked individual originality, Prof. Royce gives us a most instructive discussion of the different senses which have, in the history of human thought, been put upon the concept of Being. We are led by consideration of the complementary errors of realism and mysticism to the definition of real existence in Kantian terms as the valid, that which accords with the conditions of a "possible experience." But validity or genuine possibility must, again, rest on a basis of actual existence as part of a real experience: hence Prof. Royce conducts us from the third, or Kantian, to his own, the fourth, definition of real existence as the completed purpose or meaning of an idea. Space forbids detailed examination of his line of argument, but there are perhaps two main positions of the writer which seem hardly satisfactory as stated. It is not made sufficiently clear how it can be an "idea," in any recognised sense of the word, which ultimately sets all selective attention to work, and generally the relation between thought and will is left in some obscurity. Thus, both in the first and second series of lectures, Prof. Royce often seems to imply the very doubtful view that voluntary attention is the same thing as a volition to attend, but he nowhere explicitly states his position on the question. A minor peculiarity in the first series, which is perhaps open to attack, is the use made of certain logical theories in criticising the Kantian conception of reality. Prof. Royce might reconsider, in the light of objections with which he is no doubt familiar, but which he nowhere meets, the view, adopted by him from the writers on symbolic logic, of the universal proposition as a negative existential judgment.

To the professed metaphysician the most important thing in the two volumes will be the supplementary essay to vol. i., in which ingenious use is made of the modern theory of infinite series, as expounded by Dedekind and others, as the basis of a defence of the conception of the Absolute as a Self against the negative dialectic of Mr. F. H. Bradley. The argument cannot be dealt with here, but one difficulty may be noted. Prof. Royce, if I understand him rightly, assumes a very direct relation between validity and actuality. He appears to take it for granted that if you can reason about an infinite series in mathematics, it must be possible for that series to be actually summed; or again, that every proposition of an infinite series of propositions which would be true if made must actually be thought by some mind. As the infinite series of such minds, according to Prof. Royce's view, in its entirety makes up the mind of God, it would seem to follow that the *infinitus intellectus Dei*, which we are assured knows all that we know, just as we know it, is like nothing so much as an infinitely extended Bradshaw's Guide without an index. Before we can adopt this view, we need, I think, a more searching investigation into the relation of mathematical truth to actual fact than Prof. Royce has supplied. Is it, after all, allowable to assume without criticism that mathematical conceptions must be the exact counterpart of actual existence?

In the second series of his lectures, Prof. Royce uses the metaphysical standpoint secured in the first volume as the basis for a striking theory of the real character of the processes which appear to our senses as the physical order. His general thesis is one which seems inevitable if we accept the premisses of idealism, that what we perceive as physical nature is a vast society of purposive and intelligent beings, which appears to us to be a dead mechanism simply because we have no direct insight into the special nature of the purposive life which animates it. In connection with this general thesis, Prof. Royce supplies an invaluable criticism of the notion of uniformity or "natural law" and a most suggestive attempt at a philosophical interpretation of the empirical facts of evolution.

The concluding essays of the series contain a striking vindication of the doctrine of moral freedom and an ingenious argument for human immortality, in a sense rather different from that commonly put on the term. I hope it is not ungracious, in the presence of such a wealth of suggestive discussion of topics of vital interest, to suggest that Prof. Royce's psychology is sometimes of a doubtful kind. More than once he seems to make the contrast between my self as it is in time and my "self in eternity," with its complete insight into the solution of the problems my temporal self finds insoluble, so sharp as to amount to a positive ascription of two distinct types of existence to the same individual. His eternal self becomes, especially in the last lecture, so much a sort of lesser god, and so remote from the struggling, perplexed creature I know as my temporal self, that it is not quite easy to see how the two can ultimately be one. His doctrine of sin, deeply true as many of his statements are felt to be, again, seems to me to involve the already mentioned confusion between attending voluntarily and willing to attend. Lastly, the argument for the temporal immortality of every self might perhaps be found hardly consistent with the admission of the temporal origination of new selves by evolution. Does not evolution involve the disappearance of selves in precisely the same sense in which it involves their origination? Prof. Royce's argument, if pressed, ought to prove immortality *ex parte ante* as well as *ex parte post*. And, in view of his general acceptance of a clarified Christianity, it is not improper to ask whether Prof. Royce agrees with all serious forms of Christian doctrine in recognising the possibility that some selves may be finally "lost," and, if so, how he interprets such ultimate loss. Misgivings of this kind, however, need in no way detract from our admiration of the courage with which Prof. Royce has essayed the task of bringing idealistic philosophy into line with the positive results of empirical science, and of the vast originality and ability with which that task has been, on the whole, executed. The Gifford trustees are indeed

to be congratulated on having been the immediate causes of the publication of three such works as the Gifford lectures of Profs. Ward, Royce and James. There have been few equally important additions to English philosophical speculation in recent years. A. E. Taylor.

THE PARALLEL RUNNING OF ALTERNATORS.

Der Parallelbetrieb von Wechselstrommaschinen. By Dr. Gustav Benischke. Pp. 55. (Brunswick: Friedrich Vieweg und Sohn, 1902.) Price M. 1.20.

The second volume of "Elektrotechnik in Einzel-Darstellungen," of which the first was mentioned in these columns some time ago, appears in the above form and fully sustains, if it does not surpass, the excellent character of the first volume. Besides the general normal parallel running of alternators, including, of course, polyphase machines, the disturbing influences which make parallel running difficult or impossible are discussed. To the mathematically inclined, the theoretical explanation of the phenomena met with in the parallel running of alternating-current machinery offers exceptional opportunity for a fine display of mathematical calculations and formulæ. Fortunately, Dr. Benischke is not so inclined, and in his preface declares that the physical explanation of the phenomena appeals more directly to one's intelligence than the mathematical, and that, in the cases under consideration, the swinging and falling out of step of alternators, the mathematical method is not much good, as it is not possible thereby to prophesy whether two machines will run in parallel or not. This is, of course, what has been found in practice, and it is now usual in the construction of alternators to so design them that means for the prevention of swinging (Le Blanc's damping rings) can be placed in position should it prove necessary. The author is to be particularly congratulated on chapters x. and xi., in which these matters are discussed, for the very clear and logical manner in which he has put them.

As an introduction, the first three chapters of the book deal with the parallel running of continuous-current machinery, and the question of motor current and division of the load between the parallel sets. With continuous-current generators, the division of the load between the machines is a question for the switchboard attendant, who simply has to regulate the exciting currents, the steam-engine governors doing the rest. With alternators, the task becomes more difficult, for not only have we the additional necessity of the machines being in synchronism one with the other, but also the proper division of the load between the generators can only be attained by concurrent adjustment of both the exciting current and the steam admission. This is due to the fact that increase of the excitation of the unloaded machine is not followed by a diminution in speed due to current flowing, followed by a greater admission of steam, as in a direct-current machine, as the alternator is kept at the same speed always, being in synchronism. The proper division of the load between the alternators becomes, therefore, largely the work of the engine-driver, acting under the instructions received from the switchboard attendant, while the latter has to see that the wattless current given by the machines is kept at a minimum by the proper regulation of the exciting currents. In accordance with German practice, the author recommends the use of an indicating wattmeter or power-factor indicator on each machine to control the power factor. This has not been the usual practice in England, as the matter can just as well be done by regulating to minimum current on the machine ammeters. To-day, recording power-factor indicators are being demanded in England; this is presumably to enable the engineer to have a check on his assistants. They are also, so far as we are aware, only for use on circuits off which synchronous substation machinery is running, where the question of power factor is of greater importance than in the case now considered.

We can now only refer to the other chapters in the book, which treat of the influence of the shape of the current and electromotive-force curves, the electrical connections for parallel running with diagrams, synchronisers, under which we did not find a description of the Lincoln synchroniser, which we think is an omission, parallel running of machines situated on the same axil, and of alternators driven by gas engines. We can warmly recommend the book to all who seek trustworthy and detailed information on this important engineering subject. C. C. G.

OUR BOOK SHELF.

Hand- und Hülfsbuch zur Ausführung physiko-chemischer Messungen. By W. Ostwald und R. Luther. Zweite Auflage. Pp. xii + 492. (Leipzig: W. Engelmann.) Price 15*s.* net.

The second edition of this well-known work will undoubtedly be welcomed by a large circle of students and teachers, the more so since for some time the first edition has been out of print. The cooperation of the original author with Dr. Luther in the production of the second edition has resulted in a considerable number of changes being made in the book; a new work is, in fact, the result. Dr. Luther's long experience as demonstrator and later as subdirector of the Physico-chemical Institute at Leipzig has made him specially fitted for this collaboration, and the value of the book is greatly enhanced by the results of his daily contact with the practical difficulties of students engaged in physico-chemical work.

In the new edition, the headings of the first fifteen chapters agree with those of the first issue. Considerable changes have, however, been made in detail by the introduction of new matter. The sixteenth chapter of the original edition is represented by five chapters in the present one, the headings of which are respectively electrical measurements, electromotive force, conductivity of electrolytes (dielectric constant), quantity of electricity and transport number and finally electrical measurement of temperature. In this portion of the book, the chief work of reconstruction has been performed. The twentieth chapter deals with chemical dynamics, and a new chapter has been added on the application of physico-chemical methods to chemical questions.

Noteworthy alterations in detail are the introduction of a number of new tables of useful data, the use of the new unit for the expression of conductivity values and the inclusion of copious references to original papers dealing with the subject-matter in hand. Special forms of apparatus and details of manipulation which cannot be included in a practical text-book of anything like modest

dimensions are thus placed within easy reach of the student.

Although so rich in material, one or two omissions might with advantage be remedied in a future edition. In the chapter on measurement of pressure, no apparatus such as the differential manometer suitable for the measurement of very small pressures is described. The methods and apparatus so frequently employed in the investigation of transition phenomena of different kinds should also find a place. Such are the use of the Bremer-Frowein tensimeter, the dilatometer, the electric transition cell, &c. Apart from these omissions, the book is undoubtedly excellent. It will be found invaluable to teacher and student alike, and should find a place in every chemical and physical laboratory. H. M. D.

London Birds and Other Sketches. By T. Digby Pigott. New and enlarged edition. Pp. xiii + 256; illustrated. (London: E. Arnold, 1902.) Price 7*s*. 6*d*.

MR. PIGOTT is of opinion that every man, especially as he grows older, ought to have a "hobby," his own being the observation of birds in their native haunts. That he has recorded the results of these observations in a manner acceptable to the public taste may be taken for granted from the fact of his book having reached a third edition. Whether, indeed, he is treating of the wood-pigeons in Kensington Gardens, of the gulls and cormorants on the ornamental water in St. James's Park, of London insects, of the bearded tit in the Norfolk fens or of the sea-birds of the Shetlands and Farne Islands, the author is equally interesting; while the exquisite frontispiece by Mr. Thorburn and the other illustrations confer an additional attraction on a very charming little volume. In several instances, as in the case of gulls essaying to perch on the trees in St. James's Park, Mr. Pigott has new facts regarding bird life to place before his readers. The statement that rooks are not likely again to build in Kensington Gardens will be read with regret by all. On the other hand, bird-lovers will learn with pleasure that the bearded tit is on the increase in the Norfolk reed-brakes. Among the most interesting chapters in the volume are those on birds nesting in the Shetlands and bird life in St. Kilda.

It is, perhaps, a pity that the author did not get some professional ornithologist to look through his proofs. Had this been done, we should not have found the kingfisher, the swift and the nightjar classed as "Passeres" (p. 253) or "Regulus" given as the name of the wren (p. 22), while the statement (p. 5) that the shrikes form a link between other passerines and the birds of prey would perhaps have been modified. R. L.

How to Buy a Camera. By H. C. Shelley. Pp. xii + 144. The "How to Buy" Series. (London: George Newnes, Ltd., 1902.) Price 1*s*. 6*d*. net.

THERE are no doubt many people who would have continued to practise photography if they had had the advice contained in this handy little volume. The amateur has been, and is now, too often led to invest his money in a camera the size and bulk of which renders it impossible for him to carry it about and use except with great inconvenience. The utility, and therefore the value, of a camera to the average photographer is gauged by its facility of erection, lightness and portability, and when these qualities are combined with good workmanship in every respect, photography becomes a pleasure. In the present book, the author gives some very sound advice to the would-be photographer, and he has not forgotten to bear in mind the different sizes of pockets which have to be considered. Chapters are devoted to each of the principal items that the photographer requires, and the author seems to have shown a very fair and impartial judgment in his suggestions as to the best or most serviceable articles to be purchased. A thorough perusal of this book will effectively help anyone who wishes to take up this delightful subject, either as a hobby or as an aid to some portion of his daily work.

Recent Advances in Science. By A. E. Ikin, B.Sc. Pp. 83. (London: Normal Correspondence College Press.) Price 1*s*. net.

ACCORDING to the preface, this book has been written mainly with the object of giving pupil teachers an opportunity of obtaining some general information on the advances made in the past ten or twelve years. Unfortunately, the author shows only a superficial knowledge of his subject, and much of the information is in consequence incorrect. A good deal of it is also out of date, some of the inventions described having long since passed out of use. It may also be objected that technical terms are used much too freely in a book intended for those having no technical knowledge. Mr. Ikin's object in providing the pupil teacher with a sort of general guide to modern scientific progress is a very laudable one, but we fear it will not be realised by the book he has written. A correct description, in non-technical language, of present-day practice in the various branches of applied science would be far more valuable than a book such as this, which is likely, we fear, to do more harm than good to its readers. M. S.

Agricultural Industry and Education in Hungary. Compiled by T. S. Dymond. Pp. 177; with 98 illustrations. (Chelmsford: John Dutton, 1902.) Price 2*s*. 6*d*. net.

THIS is an account of a visit, arranged under the auspices of the Essex Technical Instruction Committee, made by the Essex farmers' party to Hungary in May and June of this year. The tour was conducted by Mr. Dymond, the lecturer in agricultural chemistry in the Essex County Technical Laboratories at Chelmsford. It would appear from these pages that excellent results are likely to follow the opportunities then given to Essex farmers to acquaint themselves with agricultural methods in Hungary. The visitors were impressed by the good farming, the abundant grain and forage crops, the breeding of excellent horses and cattle, the organisation of agricultural industries and the complete measures taken by the State to foster agricultural improvements of every kind. One of the pleasantest pieces of reading in the volume is that describing the hearty welcome extended to the party by the Hungarian authorities and people generally. A guide book, edited by the Minister of Agriculture, containing an itinerary of the journey planned under his direction, and descriptions in English of Hungarian agriculture, was, at Vienna, presented to each visitor. The party was accompanied throughout the fortnight's journey by Mr. György, Dr. Goger and Mr. Szilassy, who, as Hungarian experts in agriculture, gave invaluable assistance.

Le Ciment Armé et ses Applications. By Marie-Auguste Morel. Pp. 158. (Paris: Masson et Cie., 1902.)

THIS book, belonging to the well-known "Aide-mémoire" series, deals briefly with structures produced by the association of cement with iron or steel, distributed in such a manner as to utilise to the fullest extent the special characteristics of each. The volume opens with a description of results obtained in this field of work by numerous French engineers. Among other matters dealt with are the principal systems of applying this plan of construction to floors, girders, arches and pillars, and the materials employed. The book concludes with a set of mathematical expressions for the forms of structure approved by engineers. The text is simplified by the hundred illustrations, which, with a few exceptions, are very clear, and the book is provided with a bibliography.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Becquerel Rays and Radio-activity.

IN your report of the meeting of the Physical Society of October 31, I find the following sentence given as having been said by me in the course of some remarks on Mr. Ridout's paper on the size of atoms, with the four words which I underline accidentally omitted.

"If the electrons, or atoms of electricity, succeeded in getting out of the atoms of matter, they proceeded with *velocities which might exceed* the velocity of light, and the body was radio-active."

The omission of those four words made it appear that I had considered the velocity of the escaping electrions to be essentially the velocity of light. In reality, the electrons may escape with velocities possibly less or possibly more than the velocity of light, but certainly not all with one definite velocity.

It is probable that the electrification of air produced by the breaking up of liquids into drops,[1] by a jet of water falling through air,[2] by water-falls,[3] by the bubbling of air through water and other liquids, and by the shaking up of liquids and gases in a bottle,[4] are all to be explained by the splashing out of electrons in consequence of violent vibrations of molecules of the liquid at surfaces of separation between liquid and gas in rapid relative motion, and at places of disruption between two portions of liquid. KELVIN.

Netherhall, Largs, Ayrshire, November 27.

[The official report of Lord Kelvin's remarks was printed as received.—EDITOR.]

The Conservation of Mass.

WITH reference to the letter from Mr. Sommerville in your present issue, may I state that, in the discussion at the Belfast Meeting of the British Association, I pointed out that the height in the scale pan at which a thing is weighed affects its apparent weight and that the change from this cause is quite within the capacity of the best balances? I also referred to the last report from Sèvres by Dr. Guillaume, who made the interesting statement that it would be certainly possible now to observe that one pair of kilogram weights side by side weighed more than they would do when resting one on the other.[5]

These small differences due to distance from the centre of the earth are, however, considerably smaller than the discrepancies obtained by Dr. Landolt, but I mentioned them as representing the kind of unexpected disturbance that might come in without discovery. C. V. BOYS.

Germs in Space.

I HAVE received the enclosed letter from Mexico with a request to forward it to you; and accordingly I do so, since I suppose it not impossible that the dust of space might contain life germs of some kind. I do not think the suggested bombardment by electric corpuscles sufficient cause, though electric repulsion might sometimes act, and it has been suspected that the earth may have a faint cometary tail; but no such action is needed to account for the existence of cosmic dust of any kind.

Whether the advent of new diseases could be thus accounted for is a possible matter for debate; and incidentally it has struck me to ask whether there can possibly be any physiological discrimination between the, so to speak, windward and leeward sides of the earth on its journey through the ether, giving the morning hours a different "feel" from the afternoon hours. The idea, I admit, is extremely improbable. OLIVER LODGE.

The University, Birmingham, November 19.

[1] Holmgren, *Swedish Academy of Sciences*, 1873.
[2] Maclean and Goto, *Phil. Mag.*, August, 1890.
[3] Lenard, *Ann. der Phys. und Chem.*, 1892.
[4] Kelvin, Maclean and Galt, *R.S. Proc.* and *Trans.*, 1895.
[5] "La Convention du Mètre et le Bureau International des Poids et Mesures," p. 145 (1902).

IT is commonly assumed (*cf. e.g.* NATURE of October 16, p. 602) that if life did not originate upon the earth, it must have come upon a meteorite. How it got on the meteorite is not explained.

It occurs to me that there is no reason why small living bodies (*e.g.* spores of bacteria) should not be floating about by themselves in space. We know from recent experiments that the cold of space would not in the least destroy their germinating power, but, on the contrary, would (I presume) preserve them in a dormant state indefinitely.

Now, why should not such bodies gradually settle down upon the earth, without any destructive friction? If this can be, the meteor hypothesis becomes wholly unnecessary. [It is the *same* hypothesis: only the meteors assumed are extra small.—O. L.]

We still have to account for the living bodies in space. Is there any way in which minute particles (as bacterial spores) could leave the earth (or any other planet)? They could be carried far up in atmospheric currents, and my friend Mr. Weinzirl has found bacteria in the mountain air of the arid parts of this country. Is it possible that electric currents (such as produce the aurora) could in some cases carry them far enough to permit them to escape into space? I do not know enough about electricity to judge of this possibility.

THEO. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., November 2.

The Leonid and Bielid Meteor-showers of November, 1902.

IN a letter just now received from Mr. W. H. Milligan, in Belfast, some interesting details are given of observations made in his watch for Leonids at and near the November date of the shower's recently looked for reappearance. As a cloudy state of the sky prevailed generally in England on the nights in question, the result obtained in a prolonged clear view of the sky on at least one of the two most probably predicted mornings of November 15 and 16 for the shower's reappearance, that but one true Leonid, and no sign whatever of any great abundance of the shower, was visible in a watch of 4 hours on the first of those two mornings, possesses considerable interest from the fresh support which it affords to the lately calculated conclusions of very eminent astronomers, that the meteor-stream's celestial route, instead of just crossing the earth's orbit-track, as it did in the shower's three last previous returns and in many bygone centuries, now probably falls, by the effects of planetary perturbations on its course, sufficiently far inside the earth's orbit to no longer give us the magnificent spectacle of a great star-shower.

On the mornings of November 15 and 17, only (on the last of which the sky was overcast in Belfast), could short and tolerably clear views be here obtained of the brightly moonlit sky; and that the shower was indeed feebly active on the former morning was shown by one small true Leonid's appearance at 15h. 52m., of second magnitude, shooting overhead from $134^\circ + 47\frac{1}{2}^\circ$ to $126\frac{1}{2}^\circ + 54^\circ$, about 8° in $\frac{5}{8}$ths of a second, as from a radiant point at $151^\circ + 21^\circ$, the only meteor seen in a brief half-hour of cloudless sky well watched for the Leonids from 3h. 45m. to 4h. 15m. a.m. On the night of November 16–17, no meteor at all was visible in a full hour's watch in clear sky from 11h. 45m. to 12h. 45m. From Mr. A. King, at Leicester, I have just now heard that he observed one meteor only—a Leonid—in a 25m. watch on the latter night, and that in $1\frac{1}{2}$ hours on the early morning of November 13 (the only other cloudless time at Leicester in that November period), he observed 7 meteors, not one of which was a Leonid.

The watch, this year, for Bielid meteors on November 23–24 was about equally unproductive of both periodical and ordinary meteors; for in a watch of 4 hours' duration, from 7h. to 11h. on the first of those two nights (the next night being cloudy), Mr. Milligan reports from Belfast that no Andromede at all was there observed, and in $2\frac{1}{2}$ hours of clear sky, until midnight, here, only two shooting-stars (both in the first hour, and none in the last $1\frac{1}{2}$ hour of the watch) were seen, neither of which were Andromede or Bielid meteors. In $1\frac{1}{2}$ hour on the second night, until moonrise and cloud and rain interfered at 15h., only one true Bielid meteor and two other shooting-stars were here recorded.

Regarding his long watches at Belfast for the Leonids, in their recent period, Mr. Milligan writes thus:—

"Below I give a record of the watches kept. Although the results are few, yet from the fact of having seen three meteors—

two true Leonids and one slow, "stray," spent-looking shooting-star—in the strong moonlight, I should say that had the shower been in any force I should have seen more, and that therefore it must be taken to have been weak and to have gone past us inside the earth's orbit, as it did, presumably, in the past year or two. The radiant point was not determined, but it seemed to be in the usual position."

Date, 1902.	Duration of watch (Local Time*); a.m. From h. m.	To h. m.	Number of Leonids	Other meteors	Remarks. (* Local Times about 25m. slow on Greenwich Time.)
November 13 ..	12 0	1 0	0	0	Clear horizon-belt in E. and S.; cloudy afterwards.
November 14 ...	...	...	..	...	Cloudy throughout.
November 15 ...	12 0	2 0	0	1	Clear; moonlight (2nd magnitude meteor; very slow.)
,, 15 ...	3 0	4 0	0	0	,, ,,
,, 15 ..	6 0	7 0	1	0	,, ,,
November 16 ...	12 0	5 30	...	...	Cloudy.
,, 16 ...	5 45	6 15	0	0	Clear space around Leo.
November 17 ...	...	..	...	...	Cloudy throughout.
November 18 ..	12 0	4 0	0	0	Clear.
,, 18 ...	4 0	5 0	1	0	,,
,, 18 ...	5 0	6 0	.	..	No watch kept.
November 19 ...	5 0	6 0	0	0	Clear.
	Totals ...	...	2	1	

To complete the partial record which these notes supply of the shower's apparent strength this year, at somewhat near its time of greatest brightness, it may be hoped that more favourably observed particulars of the appearance of the Leonids may reach us yet from foreign places, and it might earnestly be wished, as well, that notes of the number of shooting-stars observed may have been kept at any distant station on the globe where possibly some sensible ramification and dense clustering of cometary dust along the wake of the departing meteor-stream may have happened to produce a fairly bright and numerous display of what it now appears probable may have to be known for some time to come, if not perhaps for all coming time, as the traditionally splendid celestial spectacle of the November Leonids. A. S. HERSCHEL.

Observatory House, Slough, November 26.

Vitality and Low Temperatures.

THE remarkable results of the experiments of Prof. Macfadyen and others, on the effects of low temperatures on organic life, render it highly desirable to ascertain how long vitality can be retained under such conditions, and with liquid air now available it becomes possible to extend the inquiry for an indefinite number of years—a generation if necessary.

The fact that organisms, after having been maintained for six months at temperatures far below those at which vital activities are possible, have retained their vitality practically unimpaired, profoundly modifies the conception hitherto attached to the word "life," and if it can be shown that vitality can survive for a protracted period in these circumstances, the conclusion that it is a molecular function seems inevitable.

If such an experimental result were obtained, it would strengthen the possibility of Lord Kelvin's speculation that the origin of life on the earth may have been ultra-terrestrial, and this implies that the ultimate source would probably have to be looked for under conditions not common to, posssibly transcending, our experience. W. J. CALDER.

Stellenbosch, South Africa.

THE BRITISH ACADEMY.

AT a general meeting of the Fellows of the British Academy, held on November 19, the Right Hon. Lord Reay, G.C.S.I., president of the Institute of International Law and president of the Royal Asiatic Society, was elected first president of the Academy.

At the same meeting, the *Times* announces, the following Fellows were elected the first members of the council of the Academy:—Sir W. R. Anson, the Right Hon. James Bryce, Prof. I. Bywater, Prof. T. W. Rhys Davids, the Rev. Prof. S. R. Driver, the Rev. Principal Fairbairn, Sir C. P. Ilbert, K.C.S.I., Sir R. C. Jebb, the Rev. Prof. J. E. B. Mayor, Dr. J. A. H. Murray, Prof. H. F. Pelham, the Rev. Prof. W. W. Skeat, Sir E. Maunde Thompson, K.C.B., Dr. A. W. Ward, Prof. James Ward.

At a meeting of the council, held on November 26, Mr. I. Gollancz, Fellow of the Academy, University lecturer in English at Cambridge, was appointed secretary of the Academy.

In the report of the anniversary meeting of the Royal Society, printed elsewhere in this issue, the position taken by the Royal Society in connection with the constitution of the British Academy is described. By its action, the Society limits its sphere of activity to that of the experimental sciences, and dissociates itself from the scientific study of archæology, philology, philosophy, political economy and similar branches of knowledge. Its scope is thus to be that of the Paris Académie des Sciences—one of the five academies which constitute the Institute of France—and the British Academy will correspond very nearly to the Académie des Inscriptions et Belles-Lettres and the Académie des Sciences morales et politiques. Many men of science regret that the Royal Society has thus ceased to represent the totality of British scientific work, as it formerly did, and has limited its scope to certain branches.

ANOTHER HODGKINS GOLD MEDAL AWARDED.

IN March last, Dr. S. P. Langley, secretary of the Smithsonian Institution, appointed a committee to consider whether any discovery had been made since the award of the first Hodgkins gold medal in 1899, under the general terms of the gift, "the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man," which would render it proper that such a medal should be again awarded. This committee consisted of the following distinguished men of science:—Mr. Richard Rathbun, assistant secretary of the Smithsonian Institution, chairman; Dr. A. Graham Bell, for electricity; Dr. Ira Remsen, for chemistry; Dr. Charles D. Walcott, for geology; Prof. E. C. Pickering, for astronomy; Dr. Theodore N. Gill, for biology; Prof.

Cleveland Abbe, for meteorology; Mr. William H. Holmes, for anthropology; and Mr. S. W. Stratton, for physics.

Owing to the absence of Mr. Rathbun, Dr. Remsen served as chairman at a meeting of the committee held at the Smithsonian Institution in Washington, April 15. At this meeting, the following resolution was unanimously adopted:—

"That the committee recommend to the secretary of the Smithsonian Institution that it is desirable that one of the Hodgkins gold medals be struck, and that it be

awarded to J. J. Thomson, of Cambridge, England, for his investigations on the conductivity of gases, especially on the gases that compose the atmospheric air."

The finding of the committee being approved by the secretary, steps were at once taken to have the second Hodgkins gold medal struck, under the personal supervision of its designer, M. J. C. Chaplain, of Paris. The medal (one side of which is shown in the accompanying photographic illustration) has recently been received by the Institution, and has been dispatched to Prof. Thomson through the Department of State.

SIR WILLIAM ROBERTS-AUSTEN, K.C.B., F.R.S.

BY the death of Sir William Roberts-Austen, which occurred at his official residence in the Mint on Saturday, November 22, metallurgical science has to deplore the loss of one of its most distinguished representatives. He had been in failing health for some months past, and had suffered from one or two sharp attacks of illness during the last few years, but even his most intimate friends, until a few days before his death, were quite unprepared for the suddenness of his end.

William Chandler Roberts, as he was formerly called, was born in 1843. His father, George Roberts, was of Welsh descent, whilst his mother, Maria Louisa, belonged to the Kentish family of Chandler which intermarried with the Austens. In 1885, at the request of his uncle, the late Major Austen, J.P., of Haffenden and Camborne, in Kent, he obtained Royal license to take the name of Austen.

At the age of eighteen, he entered the Royal School of Mines with the intention of being a mining engineer, but after obtaining the associateship of the school he became, in 1865, a private assistant to the late Prof. Graham, then Master of the Mint, and was employed, at the outset, mainly on the researches in inorganic chemistry and on physical chemistry which continued to occupy Graham until the end of his days. Graham died in 1869, when the Department was reorganised in accordance with the provisions of the Coinage Act of the following year. Under that Act, the Chancellor of the Exchequer became "Master, Worker and Warden" of the Royal Mint. No salary was attached to the office, but it was provided that its duties should "be performed and exercised by his sufficient deputy." In order to provide for the efficient discharge of the scientific work devolving on the Mint, a new post—that of "chemist of the Mint"—was created, and Roberts was selected to fill it, being appointed by Treasury minute of January 7, 1870.

On the death of Mr. Horace Seymour, the late Deputy Master, in June last, Sir William Roberts-Austen was appointed to fill the office *ad interim*, or until his own official connection with the Mint should be severed by resignation. This he had intended should take effect in the spring of the coming year. It may be said, therefore, that Sir William Roberts-Austen had, at one time or other, filled every office in the Mint which a man of his order could aspire to. No more convincing testimony to the manner in which he discharged his official duties, and no more eloquent proof of how he acquitted himself under the great responsibilities of his position, could be adduced than this single fact.

Roberts-Austen was one of the most many-sided men of his time. His intellectual activity found scope for itself in many ways. He had an insatiable capacity for work and he never spared himself. Those who knew him intimately frequently remonstrated with him on the manner in which he incessantly made large drafts on his store of mental and nervous power, with no thought of repose or recuperation. It was rarely that he could be induced to pay much heed to the warnings of his friends, declaring that he found in the very variety of his avocations the relaxation and rest which they desired him at times to take. This was strikingly exemplified by the manner in which he clung, with an interest amounting to affection, to his position as professor of metallurgy in the Royal School of Mines. Roberts-Austen always cherished, as one of the most treasured memories of his life, the recollection of his early association with the Royal School of Mines. Although the Royal School of Mines is to-day incorporated with the Royal College of Science, a fusion of which Roberts-Austen entirely approved and which he loyally supported, his colleagues on the council of the school were more or less dimly conscious that deep down in his mind, "at the back of his head," as the saying goes, he was still apt to regard the school as a corporate entity with a separate existence, with all the powers, privileges and prestige which it enjoyed as a separate entity in his old Jermyn Street days. There was probably no one position he coveted more than its chair of metallurgy, and no incident in his career which gave him a greater sense of pleasure and satisfaction than his appointment, in 1880, to that chair in succession to the late Dr. Percy. The feeling with which he regarded the school is intelligible enough, for it is very human and sprang from his very affection for it. It is akin to that which leads the fond father or doting brother in his secret soul to resent the removal of the daughter or the sister to a new home. No amount of talk about "a larger potentiality for good," "enlarged sphere of activity," "greater measure of advantages," &c., however willingly and sincerely assented to, will entirely subdue and efface the feeling which in the younger and more militant masculine members of a family has been known to degenerate into a secret wish

to punch the head of him who has presumed to impose his own name on his partner.

How loyal he was to the school, how affectionately he guarded its interests and how he studied to enhance its usefulness, I, who was his colleague on the council of the Royal College of Science for upwards of nine years, desire now to bear testimony. It was the wish of his heart, had he been spared, that, after his retirement from the Mint, he might spend his remaining years, or so many of them as the regulations of the Department would have allowed him to spend, in its service. It was possible that he cherished the hope that the erection of the new buildings on the other side of Exhibition Road might have afforded him the opportunity he had long desired, that of creating and equipping a metallurgical laboratory which should be worthy of this country and of an Empire whose sons are engaged in metallurgical work in almost every part of the globe. But if this was not to be, he has at least erected a monument to himself in the record of his past achievement; in the thoroughness and fulness of his teaching; in the scientific enthusiasm with which he sought to lay bare and illumine the problems of physical metallurgy. During the two-and-twenty years he held his chair, he trained a succession of men holding important positions at home and in many parts of the world, who are grateful to him for the stimulating influence of his teaching, who will recall many acts of personal kindness and good will, and who, now that his place in the subterranean lecture-room he loved so well and in which, with all the quickening zeal of a born teacher, he had spent some of the happiest hours of his life, knows him no more, will mourn his loss as that of a dear friend, and will continue to cherish his memory and recall the many kindly traits of head and heart which characterised him.

In the outset of his career as an investigator, Roberts-Austen occupied himself with a number of minor problems in inorganic chemistry, and there is little continuity of thought or effort to be traced in much of his 'prentice work. But there is invariably the note of originality. All his life through, he was strongly attracted by what is odd, uncommon or *bizarre*. Perhaps it was the Celtic blood which ran in his veins which predisposed him to the mysticism which was undoubtedly a feature of his character. Had he lived three hundred years ago, he would have been a typical alchemist and have spent the skill and energy he showed in assaying and minting gold in vain attempts to make it. Science, however, would certainly have been the richer for his efforts, for he was a very acute observer, and although occasionally his preconceptions were liable to run away with him for a time, especially in the direction of scientific heterodoxy, he was staunchly loyal to his facts. Much of his work was influenced by his strong artistic sense and by his passionate regard for beauty of form or colour. The secrets of oriental metallurgy had a singular fascination for him. He would literally gloat over some triumph of Japanese art, and the discovery of by what kind of "pickle," or by what kind of treatment, the lustre or colour or effect on a bronze had been obtained was a delight to him as intense as if he had lighted upon a new metal. The artistic side of his nature found frequent exercise in his work at the Mint, especially in medal-striking. He occasionally chafed under the necessity of having to make use of designs for which he had no sympathy, but he had a real delight in reproducing, with the highest degree of excellence that the resources at his command permitted, artistic work which his trained judgment and fine critical insight perceived to be good and true. Indeed, this sense of "finish" and feeling for artistic excellence, amounting almost to fastidiousness, was seen, not only in his actual manipulative work and in the way in which he arranged and perfected his experimental illustration, but in the manner and form in which he put together and presented any account of his labours. His lectures at the Royal Institution were invariably illustrations of this. Perhaps no man since Tyndall's day ever handled a Friday evening discourse with more tact and skill than did Roberts-Austen. His matter was always fresh, his experiments always interesting, frequently daring and occasionally strikingly original. He never tried to be rhetorical or pretended to be eloquent, but there was a certain literary finish in his sayings, a feeling for epigram, a sense of proportion in arrangement, and, at times, a quiet, subdued touch of humour which altogether made him delightful to listen to.

Of his innate love for science and of the ardour with which he pursued her, innumerable instances might be given. I shall never forget the manner in which he burst into my room, when at South Kensington, and showed me the first fragment of the beautiful rose-coloured alloy of gold and aluminium he had obtained. His delight was so real and unaffected—his joy almost infantile—as he turned and twisted the glittering fragment to the light to illustrate the depth and wonderful brilliancy of its purple. And, too, it was characteristic of him that, as I shared his admiration, he should, unasked, have seized a letter-weight and knocked off a portion of his prize and bade me take it.

I remember, too, a similar occasion when he carried me off to see the first results of his inquiry into the diffusion of solid metals, and when he showed me the little beads of gold cupelled out of the several sections of the block of lead, which had been standing for days and weeks on a plate of the precious metal, all arranged at the proper intervals of the sections on a diagrammatic representation to actual scale of the leaden block. And I may be pardoned if I recall with satisfaction that, as a consequence of that visit, I was the humble instrument of determining, with the powers that were, the Bakerian lecture of 1896.

The Royal Society's Catalogue of Scientific Papers records that Roberts-Austen published some two dozen papers, for the most part singly, but occasionally in collaboration with Sir Norman Lockyer, Prof. Osmond and the late Dr. Alder Wright.

They practically all relate to metallurgical problems, or are connected with the scientific side of his duties as an officer of the Mint. They deal with the spectroscopic characters of alloys; the physical and chemical nature of alloys; the structure of metals; the connection between the properties of metals and the periodic law; and the nature of the hydrogen occluded by palladium and by electro-deposited iron.

In 1890, at the request of the Alloys Research Committee of the Institution of Mechanical Engineers, he began to investigate the effects of small admixture of certain elements on the mechanical and physical properties of the common metals and their alloys. Whilst engaged on that work, he devised the recording pyrometer, an instrument which has proved to be of the greatest value, not only to the investigator in pure science, but also to the practical metallurgist. The results of these investigations are embodied in reports to the Institution of Mechanical Engineers, which afford a mass of valuable information concerning the structure of metals and their alloys, and their behaviour under varying physical conditions.

It was in the domain of physical metallurgy that he specially excelled, and by his unwearied energy, by his skill and resourcefulness as an experimentalist, he has succeeded in clearing up much that was vague and imperfectly understood in that field of inquiry.

He is the author of an "Introduction to the Study of Metallurgy," which has been characterised as a masterly guide to a knowledge of the principles on which the art is based.

This bald outline of Roberts-Austen's scientific work gives, however, a very inadequate idea of his diligence as a man of science or of the influence which he exerted on the progress of science. Such work as he engaged in was, from its very nature, time-consuming, and results were only obtained slowly and laboriously. From his official position, too, and by reason of his attainments, he was constantly pressed to serve upon committees, councils and commissions, into the work of which he never failed to throw himself with characteristic ardour and self-sacrifice. In 1885, he was a member of the executive council of the Inventions Exhibition. In 1889, he served on the British executive council of the Paris Exhibition, and in 1893 on that of the Chicago Exhibition. In the former year, he received the Cross of Chevalier of the Legion of Honour.

He sat with the writer on the Treasury Committee which preceded the establishment of the National Physical Laboratory, and he was also a member of the Board of Trade Committee appointed to inquire into the deterioration of steel rails during use in railway traction.

Since 1899, he had been a member of the Explosives Committee appointed to investigate explosives for use in the Army and Navy and material for the construction of guns.

Concurrently with the services he rendered to the State as a public servant, he did his fair share of labour in the organisation of scientific work as an executive officer of various scientific societies. He joined the Chemical Society in 1866 and served on its council in 1879–81, and became a vice-president in 1895–8.

In 1875 he was elected into the Royal Society, and served as a member of council in 1890–2, and at the time of his death was a member and chairman of some of its committees. He was one of the founders of the Physical Society, of which he was also a vice-president, and was an active member of the Society of Arts, of which he was a member of council and vice-president. He was also an honorary member of the Institution of Civil Engineers, of the Institution of Mechanical Engineers and of the Institution of Mining and Metallurgy.

He was elected president of the Iron and Steel Institute in 1899, and held office until 1901.

In 1888 he was made a C.B., and received his knighthood in the order in 1899.

The University of Durham made him a D.C.L. in 1897, and a year or two later he received the honorary degree of D.Sc. from the Victoria University.

He was a frequent attendant of the meetings of the British Association, and served as one of the general secretaries of the council from 1897 to the year of his death.

His last public lecture was the James Forrest lecture on "Metallurgy in Relation to Engineering," given to the Institution of Civil Engineers on April 23. In special lectures of this kind, Roberts-Austen excelled. They cost him considerable effort, for he spared no trouble to make the occasion worthy of himself and of his subject, and he had his reward in the grateful appreciation of his auditory.

Indeed, no man discharged more faithfully, more honourably or more religiously the obligations he had incurred, or which, by virtue of his position, were thrust upon him. It may be truthfully said of him that whatsoever his hand found to do he did it with all his might.

No sketch of Roberts-Austen would be complete without some allusion to his remarkable social qualities. When at his best he was an admirable talker, bright, witty and amusing; he had a keen sense of humour and was a capital story-teller. He had a dangerous gift, however, which in his later years he was slow to make use of—he was an excellent mimic. In the old days—the days of Rankine, Lord Houghton, Clifford, Aitchison—when the "Red Lions" were wont to hold high carnival, Roberts-Austen occasionally would "let himself go" and exercise his gift to the uproarious merriment of jackals, cubs, lions and lion-kings alike. Indeed, it seemed at times that he was not quite conscious of the faculty he possessed. I have heard him, to my terror, in the course of a conversation gradually copy the tones and inflexions of a man's voice, and seen him reproduce his manner to his very face. There was absolutely no intention to be discourteous in this, and it was done so gradually and with such subtlety that the man was just as insensible of the fact as Roberts himself. I firmly believe that on such occasions the unconscious mimicry had its origin in sympathy.

Some years ago, Roberts-Austen acquired a small place at Chilworth, near Guildford, to which he would repair with Lady Roberts-Austen on all possible occasions. It never meant idleness to him, but there is no doubt that the occasional change from the atmosphere of Tower Hill to the breezy, invigorating air of a Surrey common had some effect in preserving him from the constant inroad he made upon his physical and mental energy. His social instincts made him a good neighbour, and he spent time and no inconsiderable amount of money in improving the lot of those around him. There was one side of his character of which only those who knew him well were made fully aware. It is reflected, however, in the beautifully decorated little chapel which he erected near his house for the benefit of the district, and in which he was wont to minister nearly every Sunday.

T. E. THORPE.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Monday, December 1, when the report of the Council was presented, and the members of the Council for the ensuing year, whose names have already been given (p. 35), were elected.

The first paragraph of the report refers to the formation of the "British Academy for the Promotion of Historical, Philosophical and Philological Studies" and its incorporation by Royal Charter. The President and Council of the Society were requested by the Privy Council to give their opinion upon a petition which had been presented to the Privy Council praying that the incorporation of the studies above referred to should be "provided for in some relation to the Royal Society." The report states that in the reply the Council of the Royal Society most strongly deprecated any change in organisation being imposed upon the Society from without in order that it might include within itself the studies for which the incorporation of the British Academy is asked, being convinced that such a change would destroy the independent position which the Society now enjoys as the head, in this country, of the mathematical, experimental and natural sciences. The Privy Council subsequently invited the opinion of the Royal Society upon a memorial suggesting that it would be desirable to attempt to organise officially in one institution the several branches of knowledge. The President and Council replied that they could not consent to the Royal Society forming one department of any institution or academy such as that suggested.

The statutes governing the election of Fellows under privileged conditions, under which members of the Privy Council have hitherto been admitted, have been amended. The principal amendment provides that the Council may, once in every two years, recommend to the

Society, for election as Fellows, not more than two persons who, in their opinion, have either rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society.

Among other matters, reference is made in the report to work carried on under the auspices of the Society in connection with malaria, sleeping sickness, the West Indian eruptions, the National Physical Laboratory, the International Catalogue of Scientific Literature, the Royal Society's Catalogue of Scientific Papers, Indian observatories and the International Association of Academies.

In the course of his annual address, the President made the following remarks upon the need for increased facilities and encouragement for higher scientific education and research :—

The supreme value of research in pure science for the success and progress of the national industries of a country can no longer be regarded as a question open to debate, since this principle has not only been accepted in theory, but put in practice on a large scale, at a great original cost, in a neighbouring country, with the most complete success.

The Physikalisch-technische Reichsanstalt of Berlin, largely due to the scientific foresight of von Helmholtz, was instituted in recognition of the principle that all the industrial applications of science rest on the foundation of pure scientific discovery. The institute has for its main objects, (1) the conduct of pure physical research, especially in such directions as are suggested by industrial questions ; (2) the construction and supply of electrical and physical standards ; (3) the verification of instruments of precision for scientific and technical purposes.

The original cost of the institute was more than 200,000*l.*, and its yearly maintenance is not less than 17,000*l.* During the five years that it has been at work, its influence upon the science and the manufacturing interests of Germany has been most remarkable. Besides the publication of numerous memoirs of original research and of papers on technical processes, the direct results of the work of the institute upon the industries of the country have more than justified the prevision of the founders ; largely, we regret to say, to our own national loss, and to the almost complete passing to that country of the renown which was formerly ours in exact scientific measurements, and for the construction of standards and instruments of precision. So true is it, that the investment of public money in scientific research can only be compared to good seed cast into good ground, bringing forth in results a hundred-, or even a thousand-fold.

The sum voted by the Government for our own National Physical Laboratory, an institution second to none in its national importance, was the very modest one of 13,000*l.* for the buildings and equipment, and an annual grant of 4000*l.* for five years in aid of the expenses of conducting the work of the institution.

The supreme necessity in this country of a more systematic application of scientific methods, both in theory and in practice, to our manufactures and industries, which was so wisely insisted upon by the Prince of Wales on the occasion of his admission to the Fellowship of the Society and again in his address at the opening of the National Laboratory, has since been confirmed and enforced in a remarkable way by the individual testimonies of thirteen Fellows of this Society, in the evidence which they recently gave, from their own knowledge and experience, either as teachers of science or as leaders and technical advisers in manufactories or commercial undertakings, before a committee of the London Technical Board.

Their testimony was of no uncertain sound, but showed clearly that the Prince's words of warning were not unneeded, and that, indeed, our industries and commerce are not only in danger, but are actually passing into the hands of other countries, where scientific research is more directly cultivated under the fostering care of the State.

The undoubted present state of apathy of the national mind in relation to the importance of natural knowledge, and its consequent inability to recognise how entirely and without exception, in every undertaking, success must depend upon our so acting in conformity with the laws of Nature that we have her on our side, as our ally, and not working against us, may arise, conceivably, from either of two causes : from a natural want of enterprise and resourcefulness inherent in the national character, or from a system of education which, relatively to the educational training of other countries, fails to develop and strengthen the qualities of mind which are needed for an adequate appreciation of science.

The former of these two possible causes may surely be dismissed at once. We need only look back in history to see how this small northern island, by its own innate energy, has come to be supreme over vast regions on all parts of the earth's surface, and is now the head of an empire which engirths the world.

We are, therefore, left, without power of escape, to the second alternative, namely, that it is our system of higher education which is in fault, clearly through being too mediæval in spirit. In accordance with the traditions of the past, our higher national education deals with words rather than with things ; it is based too exclusively on the memory of what is known, and too little, if at all, on individual observation and reasoning.

The evidence seems clear that the present inappreciative attitude of our public men, and of the influential classes of society generally, towards scientific knowledge and methods of thought must be attributed to the too close adherence of our older Universities, and through them, of our public schools, and all other schools in the country downwards, to the traditional methods of teaching of mediæval times. The incubus of the past makes itself felt, especially in the too strict retention of educational methods in which the first importance is given to the reproduction of knowledge from memory, to the acquiring and applying of what is already known ; with little, if any, guidance and encouragement to the undergraduate student in the direction of research and of independent reasoning.

With the experience of Germany and the United States before us, the direction in which we should look for a remedy for this state of things would seem to be for both the teacher and the student to be less shackled by the hampering fetters of examinational restrictions, and so for the professor to have greater freedom as to what he shall teach, and the student greater freedom as to what line of study and research he may select as being best suited to his tastes and powers.

Into the dry bones of the present academic system of reading and examination must enter the living breath of the spirit of research, that is to say, of the individual efforts of each mind, for itself and in its own way, to seek to extend our knowledge in the direction most suited to its powers, by means of original observation and reasoning, and aided by the imagination—it may be in the field in science, of history and literature, or of art.

One way of bringing about reform in this direction would be to make individual research an indispensable condition of proceeding to degrees higher than the B.A.

In addition to the intellectual influence of a training in research upon the students themselves, the official recognition by the Universities of an original investigation of some subject, as a necessary condition of obtaining the higher academical honours, could scarcely fail to bring about in the public mind a more appreciative attitude in regard to the importance of original reasoning and discovery, and so to a better understanding of the meaning to be attached to natural science and to scientific methods.

It is obvious that with a fuller knowledge and appreciation of science on the part of the nation, a complete change of its practical attitude in respect to science and science questions would necessarily follow, for under such conditions public money would be liberally voted by the Government.

The work of this year's medallists was described as follows :—

COPLEY MEDAL.

Lord Lister, F.R.S.

The Copley Medal is awarded to Lord Lister in recognition of the value of his physiological and pathological researches in regard to their influence on the modern practice of surgery.

When in 1880 a Royal Medal was awarded to him, it was acknowledged that his researches had "not only reformed the whole art of surgery, but given a new impulse to medical science generally." The experience of another twenty years has written out that judgment in still larger letters. Lister's researches have made the world a wholly different world from what it was before.

The main result of those researches, namely, the definite proof that the suppuration of wounds, no less than putrefaction, was the work of living organisms, was not reached as a happy accident; it was the natural outcome of long-continued scientific observation and reasoning, the fruit of the labours of a well-trained scientific mind. Beginning with purely histological and physiological investigations having only an indirect relation to medicine and perhaps still less to surgery, he was gradually led, without changing his method or his mode of thought, to that which has so profoundly influenced both. His work has been a shining example of that which the Royal Society was founded to advance, the shaping of a new philosophy which is for the good of man.

RUMFORD MEDAL.

The Hon. Charles Algernon Parsons, F.R.S.

The Rumford Medal is given to the Hon. Charles Algernon Parsons for his success in the application of the steam turbine to industrial purposes, and for its recent extension to navigation.

The work of Mr. Parsons is of a kind which specially comes under the terms and conditions of the Rumford Medal, as consisting "of new inventions and contrivances by which the generation and preservation and management of heat and of light may be facilitated," and as "shall tend most to the good of mankind."

By his invention and perfection of the steam turbine, he has not only provided a prime mover of exceptional efficiency working at a high speed without vibration, but has taken a step forward which makes an epoch in the history of the application of steam to industry, and which is, probably, the greatest since the time of Watt. The success of the turbine is due to the experimental skill and inventive ability which have enabled him to overcome all difficulties, and to contrive a multitude of details without which the general idea of compound working could not have been translated into practice.

The use of the steam turbine for dynamo driving has been in operation for some time and is rapidly becoming common. Machines of 2000 horse-power and over are now being built. In accordance, however, with the conditions of the Rumford Trust, that the medal shall be awarded for work done within the previous two years, his claims to favourable consideration are based specially on the recent application of the steam turbine to marine navigation. The use of the steam turbine, as is well known, enabled the *Viper* and the *Cobra* to attain speeds hitherto unattainable. It has now been introduced within the last few years in vessels for mercantile purposes on the Clyde, and is being applied to ocean-going vessels.

ROYAL MEDAL.

Prof. Horace Lamb, F.R.S.

A Royal Medal is awarded to Prof. Horace Lamb for his investigations in mathematical physics.

Prof. Lamb has been conspicuous during the last twenty years by the extent and value of his contributions to mathematical physics. His writings have been distinguished by clearness, precision and perfection of form. His early work related to hydrodynamics, the "Treatise on the Motion of Fluids," published in 1879, being one of the first adequate accounts of the modern progress of that subject.

From 1881 to 1884, he published a series of memoirs dealing with the application of harmonic analysis to vibrational problems connected with spheres and other forms of bodies.

In these papers, subjects such as the subsidence of oscillations in viscous matter, the vibrations of spherical elastic solids, free electric vibrations and forced alternating currents were treated with full application to actual phenomena. In the memoirs on electrical motions and oscillations, he developed with remarkable completeness the application of Maxwell's electric theory in this department—including such topics as the surface-concentration of alternating currents—some years before the progress of the applications of electricity had led to independent experimental discovery of the importance of these phenomena.

In 1889–90, he published (*Proc.* Math. Soc. and *Phil. Mag.*) a number of valuable papers on the elastic deformation of plates and shells, which involved many new results, and also did much towards elucidating difficulties that had been encountered in this intricate subject.

Recent work has also included a discussion "On Reciprocal Theorems in Dynamics" (*Proc.* Math. Soc., 1888), a solution of the problem of the diffraction of a train of electric waves by a wire grating (*Proc.* Math. Soc., 1898), and memoirs on the dynamical theory of the refraction and selective absorption of light by gaseous media (*Trans.* Camb. Phil. Soc., 1899, *Proc.* Math. Soc., 1900). In the latter subject, he traversed ground in which he afterwards found that he had been, to a considerable extent, anticipated (in Danish) by L. Lorenz.

His treatise on "Hydrodynamics," 1895, 604 pp. demy octavo, is universally recognised as the standard presentation of that subject. It maintains the best traditions of the British school of mathematical physics.

ROYAL MEDAL.

Prof. Edward Albert Schäfer, F.R.S.

The other Royal Medal is conferred upon Prof. Edward Albert Schäfer for his researches into the functions and minute structure of the central nervous system, especially with regard to the motor and sensory functions of the cortex of the brain.

Prof. Schäfer has contributed to animal physiology much work in various lines of research, and his discoveries regarding the nervous system have been especially numerous, from the time of his demonstration of nerves in the disc of medusa to his late work on the relation of the cerebral cortex of the ape to the sensory functions of the skin. Altogether, his neurological researches rank among the most important of contemporary British contributions to that branch of physiology. It is, however, especially for his work upon the functions of one of the ductless glands—the supra-renal—that he has a claim to recognition as a Royal Medallist. In 1894 he, in conjunction with Dr. G. Oliver, succeeded in demonstrating the existence in the cortex of the supra-renal gland of a substance, called now *adrenalin*, which is the most powerful known stimulant to the cells of visceral and vascular muscles. The discovery has since been confirmed by numerous workers, British and foreign; the original researches were, however, so accurate and exhaustive as to leave little further to be added by any means available at present. The work incidentally revealed absence of this active principle in the diseased supra-renal glands in *Morbus Addisonii*, a malady considered invariably fatal. The investigation laid the first real basis for knowledge of the functions of the supra-renal gland. Recently Prof. Schäfer has, working on lines similar to his adrenalin research, extracted from another ductless gland, the pituitary, a substance exhibiting marked properties as a diuretic.

DAVY MEDAL.

Prof. Svante August Arrhenius.

The Davy Medal is awarded to Prof. Svante August Arrhenius for his application of the theory of dissociation to the explanation of chemical change.

It is not easy to over-estimate the importance of the service rendered to chemistry by Prof. Svante Arrhenius through the publication of his memoir, presented to the Swedish Academy of Sciences on June 6, 1883, entitled "Recherches sur la Conductibilité Galvanique des Electrolytes." As far back as 1886, Sir Oliver Lodge, in referring to the second part of Prof. Arrhenius's memoir, in the Report to the British Association of the Committee on Electrolysis, spoke of it as a distinct step towards a mathematical theory of chemistry, and went so far as to say that "the title affixed to it is 'The Chemical Theory of Electrolytes,' but it is a bigger thing than this—it really is an attempt at an *electrolytic theory of chemistry*." This judgment has since been amply confirmed. Whether the theory be true or not in substance, it has proved to be a working hypothesis of the utmost value, having provided chemists for the first time with the means of fully discussing the phenomena of chemical interchange in dilute solutions of electrolytes mathematically.

Since 1883, Arrhenius has been constantly occupied in extending the application of the views put forward in his first paper.

The conception of the almost complete dissociation into their ions of strong acids and bases and of many salts in dilute solution was fully developed by him in 1887, almost simultaneously with van 't Hoff's extension of the gaseous laws to solutions.

The work of the two philosophers was, in fact, complementary, and the extraordinary development in recent years of physical chemistry must be attributed to the cooperative influence of their concurrent views.

DARWIN MEDAL.

Mr. Francis Galton, F.R.S.

The Darwin Medal is conferred upon Mr. Francis Galton for his numerous contributions to the exact study of heredity and variation contained in "Hereditary Genius," "Natural Inheritance," and other writings.

The work of Mr. Galton has long occupied a unique position in evolutionary studies. His treatise on "Hereditary Genius" (1869) was not only what it claimed to be, the first attempt to investigate the special subject of the inheritance of human faculty in a statistical manner and to arrive at numerical results, but in it exact methods were, for the first time, applied to the general problem of heredity on a comprehensive scale.

The work thus begun was continued and extended in a long series of publications (*see* Bibliography in "Natural Inheritance," pp 219–20), conspicuously in "Natural Inheritance" (1889), a publication which marks a distinct advance in these studies, both by definition of the problems of variation and heredity and by the introduction of novel methods. Subsequently Mr. Galton, with a greater emphasis, enunciated (Roy. Soc. *Proc.*, vol. lxi., 1897, p. 401) the central conclusion to which his long investigations had led him, in the form universally familiar to biologists as "Galton's Law of Heredity," a principle now recognised as of wide application in nature.

Contributing to the total of Mr. Galton's work, numerous other subjects might be mentioned, which he has elucidated with a genius peculiarly Darwinian. In all his researches he has been a pioneer, and indeed, with the single exception of Quetelet, we may almost say that no one preceded him. His work is generally acknowledged to constitute a new departure in biology, and to form a natural continuation of Darwin's labours. Besides their intrinsic value, the special charm of his writings has exercised a notable influence on the minds of others, stimulating them to work in the same fields. It may safely be declared that no one living has contributed more definitely to the progress of evolutionary study, whether by actual discovery or by the fruitful direction of thought, than Mr. Galton.

BUCHANAN MEDAL.

Dr. Sydney A. Monckton Copeman.

The Buchanan Medal, awarded every five years for distinguished services to hygienic science or practice, is given to Dr. Sydney A. Monckton Copeman for his experimental investigations into the bacteriology and comparative pathology of vaccination.

Dr. Copeman is well known, both in this country and abroad, for his contributions to the scientific basis and practice of preventive medicine. His earliest work in this field was an investigation into lead poisoning from drinking water in Yorkshire. The importance and value of his "Report to the British Medical Association" was such as to at once attract the notice of the late Sir George Buchanan, and he was shortly after appointed one of Her Majesty's Inspectors on the Local Government Board. Then he commenced, and in such leisure time as official duties have left him has continuously prosecuted with remarkable success, important researches into the nature of the vaccine *virus*, and on the contaminations, bacterial and other, of vaccine lymph. His work has, besides results of theoretic importance, brought practical results in the form of great improvements in the storage and preservation of lymph used in this country. He has also shown the possibility of obtaining useful vaccine lymph by passage through animals other than the calf. It may also be added that he has contributed a considerable amount of knowledge to the physiological chemistry of animal pigments, and has elaborated a test for distinguishing between the blood pigment of man and that of other mammals, a test which is practicable for medico-legal inquiries.

HUGHES MEDAL.

Prof. Joseph John Thomson, F.R.S.

The Hughes Medal is awarded to Prof. Joseph John Thomson in recognition of his contributions to the advancement of electrical science, especially in connection with the phenomena of electric discharge through rarefied gases.

The explanation of the brilliant and remarkable phenomena attending electric discharge through highly rarefied gas has long remained an enigma, though it was early recognised by Maxwell and other philosophers that the simplicity of the conditions that must prevail in rarefied matter would probably some day furnish the key to much that is fundamental in electrical action. Following at a considerable interval the earlier work of Plücker and Hittorf, the improvement in the production and regulation of high vacua led Crookes into the exploration of a new and very striking class of phenomena, those grouped around the kathode rays, and he adduced much evidence, backed by the authority of Sir George Stokes, to show that these rays consist of streams of electrified particles projected from the kathode to the electric current. The nature and origin of these torrents of particles remained an unsolved question. Though Schuster showed that some kind of subpermanent dissociation of electrolytic character accompanied the electric discharge, his admirably planned attempt to determine the relation between the charges and masses of the kathode particles did not lead to decisive results; while the advances made by Goldstein, Hertz and others in Germany were dominated by the view that the phenomena were due to disturbances propagated in the ether rather than to projected particles. When, in 1889, Prof. J. J. Thomson announced, as the result of his measurements of the magnetic deflection of the kathode rays, their relation to the rays of Lenard, and other properties, that each kathode particle carried the normal electrolytic molecular charge and moved with a velocity which was a considerable fraction of that of radiation, and more especially that the mass of the particles was only about the thousandth part of the mass of the chemical atom, it was felt that, if these conclusions were confirmed, experiment had forced a way into the very ultimate foundations of physical phenomena, into regions which might fairly have been thought to be beyond human scrutiny. Weighty evidence had indeed already been adduced on theoretical grounds that any complete and consistent rationale of the known electrical laws almost demanded that electricity should be of an atomic character, like matter itself; and the magnetic action in spectra, discovered by Zeeman, illustrated and directed attention to this result; but no presumption was anywhere entertained that the electrical atom could so soon become the subject of direct experiment. By virtue of Prof. Thomson's own investigations, and of many others inspired and stimulated by him, this new field of knowledge has been widely extended. It is now known that the conductivities induced in gases by the Röntgen radiation, by chemical action, by radio-active substances, even by a hot wire, are closely connected in character and all take place by electric convection of such ultimate atomic charges.

It can hardly be doubted that the progress of this new department of knowledge will gradually enable us to see one whole stage deeper into the sources of physical phenomena.

NOTES.

AT the meeting of the Royal Society on November 27, the following were elected by ballot foreign members of the Society:—Prof. Waldemar Christofer Brögger, Prof. Gaston Darboux, Prof. Ewald Hering, Mr. George William Hill, Prof. Albert Abraham Michelson, Baron Ferdinand von Richthofen, Graf H. zu Solms-Laubach, and Prof. Julius Thomsen.

THE Emperor of Germany never neglects an opportunity of expressing his appreciation of the important part which science plays in national progress, and his remarks are not only encouraging to workers in all departments of natural knowledge, but also of value in determining the attitude of the public towards scientific work. In a speech at Aix-la-Chapelle in June last, he described the German Empire as mainly intellectual and scientific, and on November 28 he alluded to the same point in the course of a speech delivered at Görlitz, where a "hall of fame" has been erected. From a translation of the text of his

speech given by the Berlin correspondent of the *Times*, we take the following extract :—"We stand on the threshold of the development of new forces; our age demands a race which understands it. The new century is dominated by science—which includes technical skill—and not, like the last century, by philosophy. We must be men of the age. Great is the German in scientific investigation, great in his capacity for organisation and discipline. The freedom of the individual, the strong tendency towards development of individuality which is inherent in our race, is conditioned by subordination to the whole for the good of the whole. May the future, therefore, see the growth of a generation which, in the full recognition of these facts, develops in the course of joyous labour individuals who subordinate themselves to the good of the whole, to the good of the people and of the fatherland. Freedom for thought, freedom in the further development of religion and freedom for our scientific investigation—that is the freedom which I desire for the German people and would win for them."

Dr. Deslandres, astronomer at the Meudon Astro-physical Observatory, has been elected a member of the Paris Academy of Sciences in succession to the late M. Faye.

Prof. E. B. Poulton, F.R.S., will deliver the juvenile lectures at the Society of Arts this year, and has selected as his subject "Means of Defence in the Struggle for Life among Animals." The dates of the lectures will be December 31 and January 7.

We regret to announce that Prof. Ladislava Celakovského, professor of botany in the Bohemian University at Prague, died on November 24, at sixty-nine years of age.

The *Times* reports that the Swedish Academy of Sciences has conferred the Nobel prize of the year 1902 for chemistry on Prof. Emil Fischer, professor of chemistry at the University of Berlin, where he succeeded Prof. von Hofmann in 1892.

The Cape *Agricultural Journal* announces that Dr. A. Loir, of the Pasteur Institute, Paris, has proceeded to Bulawayo to establish a branch of the Institute there for the treatment of rabies by the anti-rabic inoculation method. Dr. Loir is a nephew of the late M. Pasteur, and has been engaged in the establishment of branches of the parent Institute at Sydney, N.S.W., and Tunis.

The death is announced of Prof. O. N. Rood, known by his work in experimental physics. We learn from *Science* that Prof. Rood was born in 1831, and was professor of chemistry and physics at Troy University from 1858 to 1863. For the past thirty-nine years he had been professor of physics in Columbia University. He had been vice-president of the American Association for the Advancement of Science and was a member of the National Academy of Sciences.

The committee of the class including agricultural practice and agricultural statistics at the Paris Exhibition of 1900 has decided to make a grant of 2400 francs to the agricultural section of the Paris Society for the Encouragement of National Industries, to be employed in agricultural research in such a manner as the committee of the Society determines. In his letter to the president of the Society, M. Tisserand, on behalf of the exhibition committee, expresses satisfaction that such a grant is possible as the outcome of the work of the section of the exhibition represented by him.

The Hon. F. M. Alleyne, member of the Legislative Council of Barbadoes, writes to say that in Barbadoes great success has been achieved in the cultivation of sweet potatoes and yams of the very best quality, and an endeavour is now being made to introduce these into this country as vegetable foods. Messrs. W. Pink and Sons, of Portsmouth, are importing regular supplies, and with every parcel receipts are sent for various ways of cooking both sweet potatoes and yams.

A Reuter telegram from Kingstown, St. Vincent, announces that the Soufrière was in violent eruption on November 26. Georgetown and Château Belair have again been deserted. Telephonic communication was interrupted early in the day owing to the fierce lightning. Rumblings could be heard and volcanic clouds seen from Kingstown. According to a telegram from St. Thomas, the steamer *Jare*, which has arrived there, reports that when she passed Mont Pelée on the morning of November 26, the volcano was in violent eruption.

Science states that Prof. J. J. Thomson has been invited to be the first lecturer at Yale University on the Silliman foundation. This lectureship, endowed by the late Benjamin Silliman with 85,000 dollars, is somewhat similar to the Gifford lectures of the Scottish universities, providing for a course of lectures "the general tendency of which may be such as will illustrate the presence and wisdom of God as manifested in the natural and moral world." The lectures, however, must not be "on topics appropriate to polemical or dogmatic theology."

The lecture which Sir Oliver Lodge delivered to the Institution of Electrical Engineers on November 27 was followed with much interest by a large and appreciative audience. The subject was "Electrons," and the lecturer made it his aim to expound the work which had been done in recent years, work in which the names of Crookes, J. J. Thomson, Stoney and Larmor stand out preeminent, rather than to attempt any new contribution to the theory. This was no easy matter before an audience composed chiefly of engineers, but Sir Oliver Lodge's powers were fully equal to giving a simple exposition of a difficult subject and making clear to his listeners the lines of reasoning involved and the legitimate inferences to be drawn from the experimental work.

Reuter's Agency understands that the work of the Commission dispatched to Uganda some months ago by the Royal Society and the Foreign Office to inquire into the cause of the mysterious malady known as "sleeping sickness," which has made such ravages in Central Africa, has not yet been completed. Dr. Low, the pathologist of the Commission, having finished his portion of the work, is returning home, but Dr. Castellan is continuing his bacteriological investigations in the country, and Dr. Christy, the third member of the Commission, as at present arranged, will pursue his studies along the Upper Nile, by which route he will return to England.

M. Calmette has claimed that antivenin, the anti-serum for snake-poison, is to a large extent non-specific, that is to say, cobra anti-serum, for example, would neutralise the venoms of other snakes, though perhaps not so actively as it would cobra venom. This view has been called in question by Prof. Martin and by Captain Lamb, and more recently Dr. Tidswell has found (*Australasian Med. Gaz.*, April 21) that Calmette's antivenin has little or no neutralising power when tested against the venom of the Australian tiger snake.

At a meeting held last week at the Polyclinic in connection with the Prince of Wales's Leprosy Fund, Mr. Jonathan Hutchinson, F.R.S., gave an exposition of his views upon the propagation of leprosy. He stated that he had come to the conclusion, after much study of the question, that the disease is spread only to a very small extent by anything of the nature of personal contagion, and that it is a food-disease, the living bacillus being received into the body by way of the stomach. The one article of food which was to be suspected was badly cured fish, eaten without sufficient cooking. Mr. Hutchinson,

who has only recently returned from South Africa, is shortly starting for a tour in Ceylon and India in order to investigate the ætiology of leprosy.

WE have received an advance copy of the second edition of Merck's Index. The bulk of the work is devoted to an alphabetical list of the multitude of substances which have been introduced of late years for medicinal use and the majority of which are not to be found in the pharmacopœias. Under each heading, the nature, chemical composition and physical properties, the uses and doses of the substance are indicated. Another useful list gives the composition of various test-solutions that are usually referred to under authors' names and the formulæ for which are often difficult to discover. Other tables give the nature and derivation of the organic substances of the materia medica, nature and composition of minerals, indicators, &c. Altogether, the work is a most useful one, both for the practising physician and for the chemist and physiologist, and should find a place in every laboratory.

A COPY of the catalogue of Aurora Borealis observed in Norway from the earliest times until June, 1878, has been received (xxiii + 422 large quarto pages, Christiania, 1902). This comprehensive catalogue was compiled by Prof. M. Tromholt; he died in 1896, and the laborious task of revising the manuscript and preparing the work for publication was undertaken by his friend, Prof. J. F. Schroeter, of the Christiania Observatory. The first portion of the catalogue gives, in chronological order, the year, month and day on which aurora was observed, together with the district and place, a short description of the phenomenon and the source from which the information was obtained, while a second section contains special descriptions of individual displays. The discussion of the results shows that, as regards the whole country, a maximum in the yearly period occurs about the times of the equinoxes (October and March), separated by a minimum in mid-winter. For the northern part of the country, north of 68° 30', the yearly period resembles that of the polar regions, with a maximum about the winter solstice. South of latitude 65°, the periods resemble those of middle latitudes. Prof. Schroeter has also tabulated the observations of Dr. Rubenson's catalogue of Swedish auroræ, and shows that the same results hold, for the yearly period, for the whole of Scandinavia, and for individual districts, as obtain for Norway only.

SOME tests on an interesting battery, in which the depolariser is atmospheric oxygen, are described by G. Rosset in a recent issue of the *Centralblatt für Accumulatoren-Elementen*. The cell consists of a zinc electrode dipping into a solution of salammoniac surrounding a porous jar; a semipermeable membrane of ferrocyanide of copper is formed in the interstices of the jar, which contains a carbon rod dipping into an ammoniacal solution of cupric oxide. When the cell is discharging, the cupric oxide is reduced to the cuprous state, but this diffuses to the surface and is reoxidised by the atmospheric oxygen. The tests show that the depolarising liquid serves for several discharges without renewal in any way, and the constancy of the E.M.F. during discharge is very good. The starting E.M.F. is about 1·25 volts, and this falls slowly to about 0·78 at the end of twenty or thirty days; the internal resistance is about 2·5 ohms. If the air is kept from the depolariser, the E.M.F. falls considerably, but recovers on its being readmitted.

THE Cambridge Scientific Instrument Company has sent us a pamphlet on the measurement of temperature by electrical means, which describes the different types of resistance and thermoelectric thermometers which they manufacture. These thermometers possess the advantage, not only of being suitable for measuring any temperature up to 1000° C. or 1500° C., but also of enabling the reading to be made at any distance from the place at which the high temperature exists. They thus do for thermometry what electrical instruments have done for electrical measurements; it is possible, for example, to read the temperature, say, of a hospital ward in the engine-room instead of in the ward itself, just as it is possible to read in the central station the electrical pressure at the consumers' terminals. The apparatus described in the list before us ranges from the simple thermoelectric couple or resistance wire in a suitable protecting tube to the elaborate Callendar recorders. Instruments reading direct in degrees centigrade can be supplied with the thermometers. The different purposes for which electric thermometry is the best, and often the only, means of measuring temperature are too numerous to mention; the convenience and high accuracy of the method will further recommend it to all who have under their control operations involving temperature regulation.

READERS of NATURE are familiar with the work which has been done by Prof. Kahlenberg tending to disprove the dissociation theory of electrolysis. A short paper summarising the principal arguments against the theory was read by Prof. Kahlenberg before the American Electrochemical Society last April. We commend this paper to all interested in electrochemical theory, especially to those who believe firmly in "ionisation." Briefly, the charges against the hypothesis of Arrhenius are the following. The very generalisation which gave birth to the theory, that abnormal osmotic pressure indicated an electrolyte, and the converse, has not been supported by further experiment. The theory, if it accounts for anything, only accounts for the behaviour of dilute solutions, and is consequently of very limited applicability. There is no experimental evidence, worthy the name, justifying the application of the theory to fused electrolytes. There is no question but that these charges are well supported, and that the ionic theory, if it has given rise to much useful work, has also greatly checked development in some directions, notably that of research with concentrated solutions. It is also a regrettable fact that writers on electrochemical subjects seem to take a pleasure in expressing *facts* in terms of the ionic theory when there is absolutely no necessity for so doing, which, doubtless, to the non-discerning, gives confirmation, in reality fictitious, thereto; without going so far as Prof. Kahlenberg and asserting that the doom of the dissociation hypothesis is already sealed, we believe that those who write in this way are running a great risk of rendering their contributions unintelligible to future generations of electrochemists.

STATISTICS of the mineral production in India for the years 1892 to 1901 have been issued by the Department of Revenue and Agriculture (Calcutta, 1902). The output of coal has increased from $2\frac{1}{2}$ to more than $6\frac{1}{2}$ millions of tons. In the same period, the production of gold has trebled, being 531,766 ounces in 1901, the value being about two millions sterling.

WE have received the general report by the director, Mr. C. L. Griesbach, on the work of the Geological Survey of India for the year ending March 31, 1902. There are brief reports on the field-work carried on in the Madras Presidency, in Burma, Assam, the Punjab, the Himalayan Ranges, Baluchistan and Sind. Inquiries into the occurrence of gold, copper and coal were made in certain districts, without, however, any important economic results. Some of the so-called old workings for gold which abound in Chota Nagpore are nothing more than old prospecting shafts and trenches, and were probably abandoned without the discovery of any paying reefs. One narrow reef gave encouraging results, but only a small outcrop was observed. Prof. R. Zeiller has completed a report on the flora of the Lower

Gondwana Series (permo-Triassic), and this is published with seven plates in the *Palaeontologia Indica* (new series, vol. ii., 1902).

THE annual report of the Geological Commission of the Cape of Good Hope for 1900 (dated 1902) has only just been received. The operations of the Survey were naturally hampered by the war, and the main work was in the districts on the west of the Karoo, including the Cederbergen and part of the country between these mountains and the sea. It was carried on by Messrs. A. W. Rogers and E. H. L. Schwarz, under the direction of Dr. Corstorphine, who has since resigned his position. Their labours have resulted in the discovery of a new formation, the "Ibiquas Series," comprising slates, sandstones and conglomerates, which overlie the Malmesbury beds and underlie the Table Mountain Sandstone. Evidence of local glacial action has been met with in the Table Mountain Sandstone. The Dwyka Conglomerate has been found to rest with marked unconformity on the older rocks as it is traced northwards. Basic dykes and sheets of the same type as those intrusive in the younger rocks of the central Karoo, have been found in nearly all of the older series of strata.

WE have received a report on the Terlingua quicksilver deposits of Brewster County, Texas (*Bulletin* No. 4 of the University of Texas Mineral Survey, 1902), by Mr. B. F. Hill, under the direction of Prof. W. B. Phillips. It is mentioned that at Comanche Spring, a small "seep," seven miles north of the Rio Grande, the limestone bluffs have been covered in a number of places with rude paintings of characteristic Indian design. The artists were without doubt the Comanche Indians, and the vermilion pigment was prepared from cinnabar. Of late years, researches have been made in the district which show that cinnabar and also native mercury occur in the Cretaceous limestones, clays and shales. These strata are invaded by eruptive rocks, to the presence of which the quicksilver deposits are considered to be indirectly due, the ore having been formed from hot springs. The cinnabar is found in definite crystals and in large amorphous masses; other mercury compounds likewise occur, while the native quicksilver is generally mixed with crystalline masses of calcite, and occupies the interstices between them sometimes in a quantity weighing twenty pounds.

THE second part of the *Aarbog* of the Bergen Museum for the current year contains a paper, by Mr. D. Bergendal, on Arctic nemertine worms, in the course of which several new generic and specific types are described. One of the former, Hubrechtella, is named in honour of the illustrious professor of zoology at Utrecht.

BY the discovery of those of the great black species (*Calyptorhynchus macrorhynchus*), which are laid in the hollow branches of gum-trees, Mr. D. le Souëf (*Victoria Naturalist*, vol. xix. No. 6) has succeeded in filling the one remaining gap in our knowledge of the eggs of Australian cockatoos.

ASYMMETRICAL development of the tracheal tubes in the fore-wings of a female specimen of the North American moth *Telea polyphemus* affords, according to Dr. G. Enderlein (*Zool. Jahrb.—Abtheil. für Anatomie*), important evidence as to the phylogeny of the Saturniidæ and the developmental history of the Lepidoptera in general.

MORPHOLOGISTS will be much interested in a paper, by Mr. E. Starks, on the shoulder-girdle of the hemibranchiate fishes (sticklebacks, flute-mouths, trumpet-fish, &c.), published in No. 1301 of the *Proceedings* of the U.S. Museum. Many emendations on previous determinations are made, and it is urged that the group is certainly entitled to rank as a suborder of equal value with the Percesoses.

THE phylogeny of the Proboscidea forms the subject of a paper by Dr. F. Ameghino published in vol. vii. of the *Anales* of the Buenos Aires Museum. The author attempts to show that the Patagonian genius Pyrotherium, which he regards as of Upper Cretaceous age, is the proximate ancestor of the group in question. This form, or its descendants, migrated into Africa, where it gave rise to the recently discovered Palæomastodon and Mœritherium, the former of which is admitted to be the progenitor of the mastodons; the latter spread over the world until one of them reached South America, the home of its ancestors! If, as is quite possible, Pyrotherium is really a proboscidean, it has to be proved, before the author's views can be accepted, first, that it is of Cretaceous age, and, secondly, that it is not itself an immigrant from Africa. It will be unnecessary to follow the author in his attempt to derive Pyrotherium—and so elephants—from a Jurassic (?) South American marsupial.

THE *Monthly Review* for December contains the first part of a contribution by the Rt. Hon. Sir Edward Fry, F.R.S., on the age of the inhabited world and the pace of organic change.

THE annual report of the Liverpool Astronomical Society, a copy of which has just been received, contains an interesting address by the president, Mr. W. E. Plummer, upon the various departments of astronomy in which observers, with or without telescopes, may do useful work if they are inspired by the true scientific spirit.

WE have received numbers 6-11 of vol. xi. and numbers 1-8 of vol. xii. of the *Transactions* of the Academy of Science of St. Louis. The separate parts are each devoted to a single subject, and there is no regular interval of time between the publication of consecutive issues. Many of the contributions are of direct interest only to American men of science, while others will appeal to scientific workers everywhere. Among the latter class in the numbers of this year may be mentioned Mr. A. S. Chessin's essays on the true potential of the force of gravity and on the motion of gyroscopes; and in vol. xi., the reviews of the progress in physics and botany in the nineteenth century, by Prof. F. E. Nipher and Dr. William Trelease respectively, and the paper on some interesting molluscan monstrosities, by Mr. F. C. Baker.

THE October number of the *Journal* of the Sanitary Institute (vol. xxiii. part iii.) contains the addresses to the various sections at the Manchester congress of the Institute. Sir James Crichton-Browne spoke upon the dust problem, and gave an analysis of the dust from a bedroom which contained more than 50 per cent. of organic matter, fragments of animal and vegetable fibres, epithelial scales, starch granules and pollen. Prof. Delépine discussed the epidemic of arsenical poisoning which occurred in the north in 1901, and stated that with Reinsch's test less than one part of arsenious acid in 10,000,000 parts of beer can be detected. Prof. Sherrington gave an interesting address upon school hygiene, and Dr. Shaw one upon the treatment of smoke, printed in NATURE of October 30 (vol. lxvi. p. 667). The popular lecture by Sir W. J. Collins was entitled "The Man *versus* the Microbe," in which he suggests that our views upon the specificity of disease and the immutability of bacteria should be modified in the light of the doctrine of evolution.

THE thirty-fifth volume of the "Journal and Proceedings of the Royal Society of New South Wales," covering the year 1901, provides convincing evidence of the scientific activity which exists in many of the important countries of the British Empire. From time to time, similar portly volumes are received from various colonies, all containing numerous important contributions to science, and it becomes increasingly difficult for a worker in any branch of knowledge to acquaint himself even with the new researches of British men of science. The volume before

us contains, in addition to the annual address by the retiring president, Prof. A. Liversidge, F.R.S., three contributions by the new president, Mr. H. C. Russell, F.R.S., one of which briefly discusses the relation between the moon's motion in declination and the quantity of rain in New South Wales, in which the author is convinced that "seeing the rain is shown so clearly to come in times of abundance, when the moon is in certain degrees of her motion south, and when the moon begins to go north, then droughty conditions prevail for seven or even eight years, a phenomenon repeated for three periods of nineteen years each, that it is either a marvellous coincidence, or there is a law connecting the two phenomena." Mr. R. H. Mathews contributes an important paper on "The Thurrawal Language," and shorter accounts of some aboriginal tribes of Western Australia and of rock-holes used by aborigines for warming water. Mr. J. H. Maiden, Government Botanist and Director of the Botanic Gardens, Sydney, gives an exhaustive summary of the gums, resins and other vegetable exudations of Australia, as well as interesting historical notes relating to the death of Captain Cook. Mr. G. H. Knibbs also writes two important papers, that on a theory of city design being of wide interest. These papers by no means exhaust the important contributions to science contained in the volume, but since reports of the proceedings of the Society regularly appear in our columns under "Societies and Academies," it is unnecessary to refer at any greater length to the scientific work being done in New South Wales.

THE additions to the Zoological Society's Gardens during the past week include two Vervet Monkeys (*Cercopithecus lalandii*) from South Africa, presented by Miss Barlow; an Equine Antelope (*Hippotragus equinus*) from Bechuanaland, presented by Major Chas. Fredk. Minchin, D.S.O.; three Fat Dormice (*Myoxus glis*) European, presented by Dr. L. H. Gough; a Mongoose Lemur (*Lemur mongoz*) from Madagascar, two Mexican Snakes (*Coluber melanoleucus*) from Mexico, deposited; two Snake Fishes (*Polypterus senegalus*) from Fashoda, received in exchange.

ERRATUM—In parenthesis near the end of letter on "Summer and Winter" (p. 81), "The average mean temperature of summer below 61°·2," for *below* read *being*.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF THE PERSEID SHOWER.—Herr Koss, director of the Pola Observatory, communicates to No. 3830 of the *Astronomische Nachrichten* the results of the observations of Perseids made at that observatory on August 8, 9 and 10.

The times of appearance, the exact path, the magnitude and the time of duration of each meteor are recorded for ten Perseids seen on August 8, sixteen seen on August 9, and thirty-three seen on August 10. In addition to these, thirteen Perseids and sixteen sporadic meteors were seen, but not mapped.

The position of the radiant point for August 9 and for August 10 was estimated to be $\alpha = 2h.\ 32m.$, $\delta = +56°\cdot5$ and $\alpha = 3h.\ 2m.$, $\delta = +54°\cdot5$, respectively.

NEW VARIABLE STAR, 16, 1902, DELPHINI.—From photographs taken at Moscow by M. S. Blakjo, Madame Ceraski has found that the star B.D. $+16°\cdot4290$, having the position $\alpha = 20h.\ 25m.\ 59s.\cdot5$, $\delta = +16°\ 57'\cdot2$ (1855), is a variable.

In the catalogue, the magnitude of this object is given as 9·3, and this was confirmed on a negative taken on August 18, 1900. On a plate obtained on August 17, 1901, however, the star does not appear, and, according to the magnitudes of the neighbouring stars which do appear, it must therefore have been fainter than the eleventh magnitude. Visual observations confirmed this latter value (*Astronomische Nachrichten*, No. 3830).

EVOLUTION OF AËROGRAPHY.—In No. 170 of the *Proceedings* of the American Philosophical Society, Mr. Percival Lowell reviews the various steps which have taken place in our knowledge and mapping of the surface of Mars.

By a series of twelve maps, arranged in chronological order, he shows the gradual development in the amount of detail seen and recorded, from the map of Beer and Madler, published in 1840, to that published by himself in 1901. From comparisons of these maps, he divides the history of aërography into three periods, viz., 1840–1876, large dark and light markings shown; 1877–1892, "canals" in bright regions detected; 1893–1902, "canals" in the dark regions detected; and also draws the following three deductions therefrom:—(1) The series agree fundamentally. (2) The regularity of the "canals," as recorded by Schiaparelli, was not due to any predisposition on the part of that observer, but was gradually forced upon him as he became more familiar with the surface of the planet. (3) All the maps show a general evolution, from simple to complex, in the detection of the surface markings of the planet.

A SIMPLIFIED FORM OF FOUCAULT'S PENDULUM.—The reinstallation of Foucault's famous experiment at the Pantheon by MM. Berget and Flammarion has, according to M. D'Arsonval, called forth many ingenious devices for proving the same result by means of a simpler apparatus.

Of these devices, M. D'Arsonval describes, in the *Comptes rendus* for November 17, the one which, in his opinion, is the simplest and best.

The main point of this device is the simplicity of the method of suspension. A steel wire, 0·035mm. in diameter, carries a leaden ball, which is covered with copper and weighs about $2\frac{3}{4}$ lbs., and is fixed to the ceiling by an ordinary nail. Its upper end is then clamped in a metal block, so that it is immovable above the lower face of the block, but free to swing about the point where it enters this face from below, and the block is then screwed to the ceiling or other suitable support. A pendulum suspended in this manner is capable of swinging for about three hours.

The whole apparatus is contained in a small wooden box, which also carries the sand in which the pendulum pointer marks the trace of its plane of swing, and is accompanied by a small model pendulum, which may be used to illustrate the principle of the invariability of the plane of oscillation.

The simplicity, the compact form and the low price (20 francs) of this device should render possible its use in schools and colleges, where hitherto the students have had to depend upon descriptions and illustrations for their knowledge of this important experiment, or else pay a visit to the western galleries of the Victoria and Albert Museum, where a large model may always be seen and, if formal representations be made to the authorities, demonstrations may be given.

PHYSICAL CHEMISTRY APPLIED TO TOXINS AND ANTITOXINS.

A VERY important contribution to our knowledge of the toxins and antitoxins is contained in the "Festskrift" recently published to celebrate the inauguration of the State Serum Institute at Copenhagen, in the form of a paper with the above title by Arrhenius and Madsen. In passing, we note with pleasure that English has been chosen as the international linguistic medium for the entire contents of the volume. The necessity for collaboration between the representatives of different branches of science for the satisfactory study of many of the complex problems of physiology, bacteriology and pathology is gradually becoming generally recognised, and in the present instance we have a striking example of the joint work of two celebrated investigators on a subject lying on the common boundary of their special provinces of knowledge and experience.

It is well known that tetanus toxin, prepared by filtering off the bacteria from a broth culture and saturating with ammonium sulphate, contains two distinct toxic substances, a *spasmin*, which produces the characteristic convulsions, and a *lysin*, which hæmolyses the red blood corpuscles of many animals. In the same way, the antitoxin produced in the serum of animals immunised against tetanus contains two distinct antitoxic substances, an *antispasmin* and an *antilysin*.

It has, moreover, been shown by Madsen that experiments on the properties and mutual relationships of the tetanus lysin and antilysin can be performed with great facility and comparatively great accuracy on blood *in vitro*, the uncertainty attendant upon animal experiments and the great expenditure of time required by them being thus avoided.

The aim of the present investigation was to study the hæmolytic action of tetanus lysin and its reaction with antilysin in the light of ordinary chemical reactions, and to compare both these phenomena with similar actions brought about by substances of known molecular weight, constitution and purity.

The method of estimating the hæmolytic power, which was employed in all the experiments, consisted in allowing the substance under examination to act for a given time upon an emulsion in normal saline, or other liquid, of a known quantity of well-washed blood corpuscles, and then estimating the amount of hæmolysis produced colorimetrically by comparison with standard tubes prepared from varying quantities of the same blood by complete hæmolysis with distilled water.

The investigation falls naturally into two parts, the first of which deals with the hæmolytic action of tetanus lysin compared with that of caustic soda and ammonia.

The hæmolysis of a blood corpuscle by a base such as caustic soda or by tetanus lysin is a phenomenon of considerable complexity and appears to take place in two stages—the combination of the hæmolytic agent with the material of the corpuscle, and the hæmolysis of this compound by the "lysin" which remains free. The three substances under investigation differ from each other in the rate at which they unite with the corpuscles and also in the stability of the compounds which are produced.

Caustic soda combines very rapidly and forms a very stable compound; the consequence of this is that when a certain definite number of blood corpuscles are present, practically the whole of the alkali is taken up and very little hæmolysis occurs. With small amounts of blood, hæmolysis is complete, but as the amount of blood is increased beyond the amount which can be completely hæmolysed, the alkali is thereby withdrawn in increasing amounts from the solution, so that the extent of hæmolysis rapidly diminishes. Tetanolysin, on the other hand, combines much more slowly with the corpuscles and forms a much less stable compound, which is partially decomposed into its constituents, or hydrolysed, by the water of the solution. Hence, in the case of the lysin solutions, there is always some free lysin to effect the hæmolysis of the lysin-corpuscle combination, and, as a consequence, the falling off after the maximum is not nearly so marked. Ammonia takes up a position intermediate between caustic soda and lysin.

All these hæmolytic actions are affected by the presence of certain foreign bodies, among which salts, albumin and serum have hitherto been examined. It seems probable that salts have two distinct effects. In the first place, they probably render the corpuscles more susceptible to the attack of the hæmolytic agent, and hence tend to increase hæmolysis. This tendency is not counteracted in any way in the case of the tetanus lysin, and hence an increase in the action is in this case observed. The compounds of the alkalis with the corpuscles, on the other hand, are affected by salts containing the same ion, much in the same way as a weakly dissociated salt, in which case the dissociation is decreased and the salt then enters less readily into reaction. Hence the caustic-soda combination is affected in this way by sodium salts and, since the diminution of hæmolysis thus produced outweighs the increase due to the effect of the salt on the corpuscles, a nett decrease of action is observed. The ammonia combination is less strongly dissociated than the soda combination, and is therefore still more strongly affected by the presence of ammonium salts.

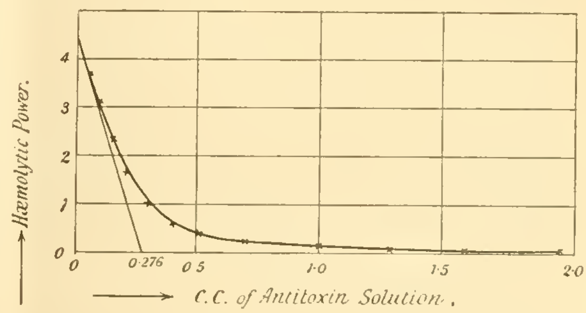
The dissociation spoken of in this case is the electrolytic dissociation of a salt or salt-like compound into its ions, and must not be confused with the hydrolysis mentioned above. Thus a salt-like sodium carbonate is at the same time partly dissociated into its ions, and partly hydrolysed by the water of the solution into caustic soda and carbonic acid; sodium chloride, on the other hand, is much more completely dissociated into its ions, but is practically not hydrolysed at all.

The effect of egg albumin and normal serum is also to diminish the hæmolytic power, both of the bases and of tetanus lysin, but whilst the effect on the bases is very slight, that on the lysin is considerable. It would seem that in each case the albumin combines with the hæmolytic agent, forming a compound in which the hæmolytic power is modified to a certain extent. The properties of caustic soda and ammonia are only slightly affected; those of the tetanus lysin, on the other hand, are more profoundly modified. This explanation is confirmed by the fact that the further addition of albumin exerts no appreciable effect after a certain limit has been reached. Normal serum, on the other hand, has a progressively increasing effect on the lysin, and in fact behaves like a mixture of a large amount of albumin with a small amount of an antitoxin.

Further information is gained as to the nature of the hæmolytic action by the determination of the velocity of the change, and this reveals a still greater complexity. The reaction exhibits a very decided *period of induction*; when the substances are first mixed, the change begins to take place at a very low rate, which gradually increases as the change proceeds. Such a period of induction occurs in certain well-known chemical reactions, although its exact significance is not perfectly understood. In the case under consideration, the authors suggest that it "depends on the circumstance that the red blood corpuscles' cellular membrane must be destroyed before hæmolysis can occur." The actual velocity is found to be proportional to the concentration of the hæmolytic agent, so that if the dose be doubled, the time required to produce a given amount of hæmolysis is halved. This result is of great importance because it shows that the hæmolytic action of bases is not due to the hydroxyl ions, in which case the velocity would be proportional to the square root of the concentration. The same thing is shown by the fact that ammonia acts more rapidly than caustic soda, although it is much less strongly dissociated.

The second part of the investigation deals with the important subject of the action of the antilysin on tetanus lysin.

When increasing quantities of antilysin are added to a fixed amount of lysin, the hæmolytic power of the mixture is not diminished in direct proportion to the amount of antilysin added, but the effect of each successive portion of antilysin is less than that of the preceding one, the diminution of hæmolytic power being rapid at first and then becoming more and more gradual. If the results be plotted with the amounts of



antilysin added as abscissæ and the hæmolytic powers of the resulting mixtures as ordinates (the amount of lysin being constant throughout), a curve of the form shown above results. This curve represents what is usually know as the *toxin spectrum* of Ehrlich.

When we compare this phenomenon with the action of an acid on an alkali, we find that it does not resemble what occurs when an equivalent of hydrochloric acid is added to caustic soda, for in this case the alkalinity diminishes in direct proportion to the acid added, the last portion of acid having exactly the same neutralising effect as the first.

On the other hand, it corresponds precisely with the phenomena observed when a base such as ammonia is treated with a weak acid, like boric acid. In fact, if ammonia be treated as a lysin and boric acid as an antilysin, and hæmolytic experiments be made in precisely the same way as with tetanus lysin and antilysin, the curves of hæmolytic power produced in the two cases are of precisely the same kind. Now the phenomena which occur when boric acid is added to ammonia and in similar cases have been carefully examined by physical chemists, and they are known to be due to the fact that, in a solution of this kind, the ammonium borate which we should expect to be formed is partially hydrolysed by the water into its components, so that the liquid contains ammonium borate, water, free ammonia (ammonium hydrate) and free boric acid. The case is susceptible of mathematical treatment according to Guldberg and Waage's law, and the equivalents of the substances and the coefficient of dissociation can be calculated from the observations.

Precisely the same can be done for the tetanus lysin and antilysin, and the natural conclusion is that these two changes are of the same kind, a reaction taking place in each case between two molecules and resulting in the formation of two molecules of the products. It does not in any way follow that the *substances* concerned are of the same chemical type, and in fact other considerations render this very improbable.

In the particular experiment quoted, the amount of antilysin solution which was chemically equivalent to the lysin employed was 0·276 c.c. When this quantity of antilysin was added, however, the hæmolytic power remained equal to 36 per cent. of the original, whilst even after the addition of seven times the equivalent, the power was still 1·8 per cent. of the original. These facts, nevertheless, do not indicate the presence of a series of lysins of different hæmolytic powers and affinities for antilysin, any more than the precisely similar phenomena observed with ammonia and boric acid indicate the presence of a series of bases possessed of different hæmolytic powers and affinities for boric acid. It is therefore unnecessary to suppose, as Ehrlich has done for diphtheria toxin, that proto-, deutero- and trito-toxins as well as toxones are present.

All the phenomena are explained by the presence of a single lysin, the compound of which with its antilysin is partially decomposed into its constituents by water. Recent experiments of Dreyer and Madsen show that these conclusions may fairly be extended to the constitution of diphtheria toxin.

The deterioration of tetanus lysin is a subject of great interest in connection with the theory of toxins, and its study has also yielded interesting results, although it has not yet been pushed very far. The examination of an altered lysin by the method described above serves to indicate which of its constants—the equivalent or the coefficient of dissociation—has been altered. To take a single example, the hæmolytic power of a solution of lysin was found to have diminished to one-sixth in about five days. Examination showed that its equivalent had not altered, but that its coefficient of dissociation had increased by 50 per cent. As a result of this increase, the hæmolytic power of this lysin would be diminished to a less extent than that of the original lysin by a given dose of antilysin. The effect of deterioration in this case can therefore be explained by supposing a slight change to have occurred in all the molecules of the lysin, "perhaps a transformation into a metameric compound, less toxic," possessing an increased coefficient of dissociation and an undiminished combining power for antilysin. Ehrlich's explanation, on the other hand, would be that five-sixths of the lysin had been converted into a non-hæmolytic substance (toxoid) which had a greater affinity for the antilysin than lysin itself and was therefore "neutralised" first.

This explanation may be applicable in some cases, but, as will be seen, it is not necessarily required by the facts.

A further point of interest is that lysin and antilysin unite slowly and at a rate which can be measured. The investigation of this reaction has been carried out to a certain degree, and its further examination will probably throw more light on the nature of the change which occurs.

If the results of the authors are accepted, a great simplification of the present ideas as to the constitution of toxins will be necessary. A point which is of fundamental importance and appears to call for further examination is the mode of action of the lysin molecule in hæmolysis. In other words, does hæmolysis take place between the lysin-corpuscle and free lysin, as is the case with caustic soda, or does the lysin molecule which forms the combination bring about the hæmolysis by means of another group contained in its molecule?

A. HARDEN.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An important change has recently been made in the regulations for Responsions. The change affects the examination in the Elements of Geometry. Instead of Euclid's Elements Books i. and ii., with Euclid's axioms and Euclid's sequence of propositions, the subject will in future be defined as the subject-matter of certain specified portions of Euclid's Elements Books i., ii., iii., and the papers will contain elementary questions on this subject-matter and easy deductions from the specified propositions. The regulations state that any method of proof will be accepted which shows clearness and accuracy in geometrical reasoning, and that algebraical proofs of certain propositions in Book ii. will be allowed. The change is to come into force in the Michaelmas term of 1904. The announcement made by the Board of Studies for Responsions, in the *University Gazette* for November 25, reads as follows:—"In the regulations as to the Elements of Geometry (*Examination Statutes*, 1902, p. 18), the words 'Euclid's Elements, Books i., ii. Euclid's axioms will be required, and no proof of any proposition will be admitted which assumes the proof of anything not proved in preceding propositions of Euclid,' have been struck out, and the following words substituted:—'Elementary questions, including propositions enunciated by Euclid and easy deductions therefrom, will be set on the subject-matter contained in the following portions of Euclid's Elements, viz., Book i., the whole, excluding propositions 7, 16, 17, 21; Book ii., the whole, excluding proposition 8; Book iii., the whole, excluding propositions 2, 4–10, 13, 23, 24, 26–29. Any method of proof will be accepted which shows clearness and accuracy in geometrical reasoning. So far as possible, candidates should aim at making the proof of any proposition complete in itself. In the case of propositions 1–7, 9, 10, of Book ii., algebraical proofs will be allowed.' This change will come into force at the examination of Michaelmas term, 1904."

Sir Oliver Lodge has been appointed the Romanes lecturer for next year.

ON Wednesday evening, December 10, a paper on "French Rural Education, and its Lessons for England," will be read by Mr. Cloudesley Brereton at the Society of Arts.

THE clerk of the Privy Council has sent an official notice to the authorities at University College, Liverpool, fixing the hearing of the petition in regard to the proposed Liverpool University for Wednesday, December 17.

THE annual meeting of the Association of Technical Institutions will be held at the Goldsmiths' Hall, London, on Tuesday, January 6, 1903. The president, Lord Avebury, will occupy the chair, and an address will be given by the president-elect, Sir John Wolfe Barry, K.C.B., F.R.S.

MR. J. S. MACDONALD has been appointed to succeed Prof. Myers-Ward in the chair of physiology at Sheffield University College. Mr. Macdonald, who is at present assistant lecturer in physiology at Liverpool University College, takes up his new appointment in January next. Prof. Myers-Ward goes to Charing Cross Hospital as lecturer in physiology.

THE *British Medical Journal* announces that the Board of Trustees of Cornell University, New York, has arranged to purchase sixteen additional acres of land, and to erect new buildings, including the Hall of Physics, for which Mr. John D. Rockefeller gave a quarter of a million dollars, and a Hall of Arts and Humanities, upon which a like amount is to be expended. In connection with this University, it is of interest to notice that professors of the University who reach the age of seventy years will hereafter be retired with a pension. Their salary will be continued for one year, and they will thereafter receive 1500 dollars a year for four years, which time will doubtless be extended. They will act as special lecturers with such duties as may be assigned to them.

WE regret to see that Sir Michael Foster has written to the chairman of his Parliamentary Committee to say he feels compelled to resign his seat as member of Parliament for the University of London. He hoped to be relieved of his duties in the House of Commons at the beginning of the present term, but now, at the request of his committee, has deferred his actual resignation until the close of the present session. Among the names mentioned in connection with the vacancy thus caused are those of Sir Henry Roscoe, for some time vice-chancellor of the University, and Sir John Williams.

WRITING to the *Times*, Mr. A. C. Holzapfel points to the striking difference between English and German fees for scientific instruction. One of his sons studied chemistry at Aachen, and the fees for lectures, laboratory work, breakages, &c., were between 6*l.* and 7*l.* yearly. Another son attended King's College, London, for a course of work similar to that

his brother had had in Germany, and the fee was 47*l.* 13*s.* 9*d.* for a year. The explanation is given by the secretary of the London college, who pointed out in a letter to Mr. Holzapfel that "the continental colleges are endowed by the State, but in England they have to live on the fees of students for the most part, with a very small grant from the State in some cases and what they can raise voluntarily from the public." But it is evident that while the highest form of instruction in science can be obtained at so small a cost, there will never be a lack of properly trained men to look after the manufactures of Germany.

FULL particulars have now been published of the first annual conference of persons in the north of England concerned in primary, secondary, technical and other forms of higher education, which was announced in our issue for July 17. The conference will be divided into four sessions—two meetings on each of the days January 2 and 3, 1903—presided over respectively by Mr. M. E. Sadler, director of special inquiries to the Board of Education; Prof. H. E. Armstrong, F.R.S., Prof. Smithells, F.R.S., and Prof. L. C. Miall, F.R.S. There will be a reception by the Lord Mayor of Manchester of members of the conference on January 2, in the Municipal School of Technology, Manchester, where the meetings will be held, after which various papers will be read. Miss S. A. Burstall, head mistress of the Manchester High School for Girls, will take up the subject of the curriculum in different types of schools. Dr. Kimmins, at the afternoon meeting of the first day, deals with the coordination and delimitation of science teaching in various grades of schools. The methods of teaching experimental science in its early stages will be discussed on the morning of January 3, Mr. W. French, principal of the Storey Institute, Lancaster, taking up physics, and Mr. R. L. Taylor, of the Central School, Manchester, considering chemistry. At the last meeting, Mr. H. W. T. Wager will introduce the subject of methods of nature-study. Great care has been taken to encourage discussion at each meeting; the names of well-known teachers are included in the programme as having promised to contribute to the debates. In connection with the conference, there will be an exhibition of apparatus, preparations and diagrams, such as teachers themselves have prepared or which pupils have made, to illustrate methods of nature-study and the teaching of experimental science. A class-room, fitted up as a model of what it is desired should be provided for the teaching of physics and chemistry in their early stages, will form part of the exhibition. The admission to the conference will be free, by ticket, to be obtained from the honorary secretaries, Dr. H. Lloyd Snape, Director of Education to the Lancashire County Council, and Mr. J. H. Reynolds, Director of Technical Instruction for the city of Manchester and principal of the Manchester Municipal Technical School, which is the office of the conference.

SCIENTIFIC SERIALS.

Transactions of the American Mathematical Society, vol. iii. No. 4 (October).—G. A. Miller, on the groups of order p^m which contain operators of order p^{m-2}. It appears that if $p>2$ and $m>5$, there are two and only two such groups not containing either an invariant cyclic subgroup of order p^{m-2} or else an abelian subgroup of type $(m-2, 1)$. These two groups are conformal respectively with the abelian groups of type $(m-2, 2)$ and of type $(m-2, 1, 1)$.—C. A. Scott, (1) on the circuits of plane curves; (2) on the real inflexions of plane curves.—J. Hadamard, on the theory of plane elastic plates.—E. J. Wilczynski, covariants of systems of differential equations, and applications to the theory of ruled surfaces. The system considered is $y''+p_{11}y'+p_{12}z'+q_{11}y+q_{12}z=0$ and another similar equation with z'' for y''. All covariants can be expressed in terms of three, together with invariants.—A. S. Gale, on the rank, order and class of algebraic minimum curves.—H. F. Blichfeldt, on the determination of the distance between two points in space of m dimensions. Without assuming the continuity and independence of the coordinates, but assuming that distance-relations exist, a series of axioms is laid down and possible forms deduced for the analytical expression for the distance between two points.—H. Maschke, on superosculating quadric surfaces.—E. H. Moore, a definition of abstract groups.—A. Emch, algebraic transformations of a complex variable realised by linkages.

American Journal of Mathematics, vol. xxiv. No. 4 (October).—M. Bôcher, on systems of linear differential equations of the first order. This contains proofs of some existence-theorems by a method of successive approximation.—T. M. Putnam, on the quaternary linear homogeneous group and the ternary linear fractional group. The determinant being unity, and the group being symbolised by substitutions, the canonical forms of the generators fall into eleven principal types, with various subdivisions. The periods of the substitutions are considered, and different commutative subgroups investigated.—A. N. Whitehead, on cardinal numbers. The results of this paper are all expressed in Peano's symbolism, on which there is an introductory section.—G. A. Miller, on a method of constructing all the groups of order p^m (p being any prime).—H. F. Stecker, non-Euclidean properties of plane cubics and of their first and second polars. This is a continuation of a former paper in vol. xxii. of the same journal.

Annals of Mathematics (2) vol. iv. No. 1. (October).—G. A. Bliss, on the geodesic lines on the anchor-ring. The author obtains explicit formulæ, involving elliptic functions, which define a doubly infinite family of geodesics. He also shows that, according to Mangoldt's classification, the points on the inner equator are of the first kind and all others of the second kind. Good illustrative diagrams are given.—H. F. Blickfeldt, proof of a theorem concerning isosceles triangles.—L. E. Dickson, an elementary exposition of Frobenius's theory of group-characters and group-determinants.—E. V. Huntington, on Mr. Ransom's mechanical construction of conics.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 19.—Dr. J. Emerson Reynolds, V.P.R.S., president, in the chair.—The "dynamic isomerism" of thiourea and ammonium thiocyanate. When the ammonium salt is heated, there is formed a definite compound of this with 25 per cent. of thiourea formed from it; further, melting-point curves of mixtures of these two substances show that other molecular combinations occur.—Isomeric partially racemic salts containing quinquevalent nitrogen; part 8, resolution of the hydrindamine camphor sulphonates, by Dr. F. S. Kipping. The author has confirmed the theory proposed by him in 1899 to account for the existence of these salts by the resolution of the partially racemic salt into four isomerides.—The oxime of mesoxamide and some allied compounds, by M. A. Whiteley. A description of the disubstituted derivatives of mesoxamide, all of which possess the characteristic properties of furnishing yellow alkali salts and purple ferrous compounds.—Interaction of ketones and aldehydes with acid chlorides, by F. H. Lees. When methyl n-nonylketone is acted upon by benzoyl chloride, there is formed β-benzoxyundecylene; this reaction has been extended to other ketones, and a series of benzoxyolefines so produced.—The synthesis of $\alpha\alpha$-dimethylglutaric acid, hydroxy-$\alpha\alpha$-dimethylglutaric acid, and of the *cis*- and *trans*-modifications of $\alpha\alpha$-dimethylglutaconic acid, by Dr. W. H. Perkin and A. E. Smith.—A reaction of some phenolic colouring matters, by A. G. Perkin and C. R. Wilson. Potassium derivatives of a number of naturally occurring colouring matters have been prepared by interaction with potassium acetate.—Note on mixtures of constant boiling point, by Dr. S. Young. The composition of the mixture of carbon tetrachloride and methyl alcohol having the minimum boiling point is shown to contain 80 per cent. of the former.—The vapour pressures and boiling points of mixed liquids, part 2, by Dr. S. Young and E. C. Fortey. Part 3, by Dr. S. Young. An investigation of the formula proposed by the authors expressing the relation between the vapour pressure of the mixture and those of its constituents. Note on the condensation points of the thorium and radium emanations, by E. Rutherford and F. Soddy. When the emanations from thorium and radium compounds are passed through a copper spiral immersed in liquid air, they are condensed and retained in the copper tube and are volatilised when the temperature is raised to $-125°$ in the case of thorium emanation and to $-130°$ in the case of radium.—Note on the action of barium hydroxide on dimethylvioluric acid, by M. A. Whiteley. The principal product of this action is isonitrosomalondimethylamide.—The determination of strychnine and brucine in nux vomica, by E. Dowzard. The brucine is determined by colorimetric estimation of the tint produced by the solution of the alkaloidal residue in nitric acid.

Entomological Society, November 5.—The Rev. Canon Fowler, president, in the chair.—Mr. H. J. Elwes, F.R.S., exhibited, on behalf of Mrs. Mary de la Bèche Nicholl, a collection of butterflies made by her in February, March and April in Southern Algeria; also a collection of butterflies afterwards made by her in the Picos de Europa in Spain; the latter collection comprised about 85 species and was made in 25 days. Mr. Elwes remarked that these collections contained several interesting species of Erebia, Lycæna and other genera, and included three species from Algeria not at present represented in the British Museum collection.—Dr. Chapman exhibited, and made remarks on, two butterflies taken last July at Bejar, in West Central Spain, both notable as being very decidedly larger than any forms of the same species recorded from any other locality. He stated that one of them belonged to a form of *Lycaena argus* (the *L. aegon* of the British list). They were taken about one-and-a-half miles east or south-east of Bejar on July 9 and following days.—Mr. R. South exhibited four specimens of a large form of *Cupido minima* (*Lycaena minima*) from Cumberland, sent to the Natural History Museum by Mr. Mousley, of Buxton. He also exhibited, on behalf of Mr. J. H. Fowler, of Ringwood, a series of *Lithosia deplana*, Esp., from the New Forest, showing interesting variations in both sexes, but especially in the females. It was stated that Mr. Eustace Bankes had recently recorded somewhat similar aberrations of the species from the Isle of Purbeck.—Mr. Hamilton Druce exhibited a specimen of *Limenitis populi*, L., caught whilst being chased by a small bird in July, 1901, near Riga, Russia; also a specimen of *Sesamia nonagrioides*, Lefeb., bred from a larva found feeding in the interior of a banana.—Mr. J. H. Carpenter exhibited a gynandromorphous specimen of *Lycaena icarus*, having the coloration of the male on the left side and that of the female on the right side, captured on Ranmore Common, Surrey, in June last; also several aberrations of this species from Ranmore Common and the Isle of Wight. He also showed specimens of *Vanessa antiopa*, bred from German larvæ, including a remarkable aberration in which the usual blue spots on the upper wings were entirely absent.—Mr. H. St. J. Donisthorpe exhibited a foreign specimen of *Quedius suturalis*, lent him by Mr. Keys, of Plymouth, and a British specimen taken by himself at Gravesend in 1891; also for comparison a specimen of *Quedius obliteratus* taken at Plymouth. He said that most of the specimens of, so-called, *Quedius suturalis* in British collections were really *Q. obliteratus*.—Mr. Pickett exhibited a remarkable series of *Angerona prunaria*, the result of four years' inter-breeding between dark males from Raindean Wood, near Folkestone, and light-coloured females from Epping Forest; also unicolorous light orange-yellow males, light yellow females, dark orange males sprinkled with black, and other unusual aberrations.—Prof. E. B. Poulton, F.R.S., exhibited a series of lantern slides prepared from negatives taken by his assistant, Mr. A. H. Hamm, of the Hope Department, and Mr. Alfred Robinson, of the Oxford University Museum. The slides represented a series of the larvæ and imagines of British moths photographed under natural conditions.—Prof. Poulton also showed a representation of the pupa of *Limenitis populi* prepared from Portschinski's figure and description, and explained the highly ingenious hypothesis by which the appearances are accounted for by the Russian naturalist.—Mr. C. O. Waterhouse communicated a paper by Mr. L. R. Crawshay entitled "On the Life-History of *Drilus flavescens*, Rossi."

Zoological Society, November 18.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—Dr. Henry Woodward, F.R.S., exhibited two photographs of the heads of stags of the red deer (*Cervus elaphus*) bred in New Zealand, lent to him for exhibition by Mr. Lewis Karslake. Dr. Woodward read an extract from a letter from Mr. D. Russell, hon. sec. to the Otago Acclimatisation Society, giving an account of the successful naturalisation of the red deer in New Zealand. Two stags and six hinds had been turned out in 1868, and their offspring now numbered between 4000 and 5000 individuals. The carcases of some of these deer weighed from 500 to 600lb.—Mr. J. L. Bonhote exhibited some hybrid ducks which he had bred during the past summer, and pointed out in what manner the crosses partook of their parent forms. Three of the specimens exhibited were crosses between three species, viz. the Indian spot-billed duck, the wild duck and the pintail, both the parents being themselves hybrids, thus proving, with regard to the species enumerated, that the hybrids were perfectly fertile *inter se*.—Mr. Oldfield Thomas, F.R.S., exhibited and made remarks upon a stuffed male and the skull of a female of the East-African representative of the Bongo antelope, recently described by him as *Boocercus euryceros isaaci*, which had been obtained by Mr. F. W. Isaac in the Mau Forest and presented by him to the national collection.—Mr. Thomas also exhibited, on behalf of Mr. Lydekker, the mounted skin of an adult male of the Peking deer (*Cervus* [*Pseudaxis*] *hortulorum*), recently presented by the president and the Duchess of Bedford to the British Museum. Mr. Lydekker believed that an adult specimen of this fine stag had not hitherto been figured. The specimen was in full summer dress.—Dr. A. Smith Woodward, F.R.S., gave an account of excavations for the discovery of early Pliocene mammalian remains which he had recently made near Concud, in the province of Teruel, Spain. The bones had proved to be very abundant in a bed of freshwater marl, but they were in a much more fragmentary condition than those found at Pikermi, in Greece. He had discovered evidence of Hipparion, Rhinoceros, Mastodon, and of several small antelopes, and exhibited some jaws of the first of these genera.—Mr. F. E. Beddard, F.R.S., exhibited the stuffed skin of an Indian elephant still-born in the Society's menagerie in August last, and made some remarks thereon.—A communication was read from Mr. R. Lydekker, F.R.S., containing a description of the Cabul race of the markhor (*Capra falconeri megaceros*).—Dr. Forsyth Major read a paper on the specimens of the okapi that had recently arrived in Brussels from the Congo Free State. The author stated that these specimens, whilst presenting the same specific characters as the specimens formerly received by the Congo State authorities, showed conclusively that the male was alone provided with horns, and that the mode of their development was the same as in the giraffe. The okapi seemed to be a more generalised member of the Giraffidæ than the giraffe, sharing not a few features of alliance with the Upper Miocene Palæotragus (Samotherium). In several characters, it was intermediate between the giraffe and the fossil forms; but, apart from these, some features were pointed out in which it appeared to be even more primitive than its fossil relatives. These last characters went some way to support the assumption that Africa was the original home of the Giraffidæ.—A communication was read from Mr. G. A. Boulenger, F.R.S., containing an account of a second collection of fishes made by Dr. W. J. Ansorge in the Niger Delta. The species—fifty-six in number—were enumerated, four of them being described as new.—A communication from Dr. A. Günther, F.R.S., contained a final account of the fishes collected by the late Mr. R. B. N. Walker, on the Gold Coast. Several new species belonging to the families Chromidæ, Siluridæ and Cyprinidæ were described.

Anthropological Institute, November 25.—Dr. A. C. Haddon, F.R.S., in the chair.—Dr. C. S. Myers read a paper on anthropometric investigations among the native troops of the Egyptian Army. The investigations were confined to the privates and non-commissioned officers of the Egyptian Army. By permission of the Sirdar, 1005 men in the Egyptian battalion quartered at Cairo and 189 men in the Soudanese battalions at Khartoum and Omdurman were examined. Photographs were obtained of 176 Egyptians and thirty-one Soudanese soldiers bare to the waist; two photographs, one full-face, the other profile, were taken of each individual. In both Egypt and Soudan, the subjects measured had been drawn from a very wide area, extending as far westward as Bornu and Barū, and southwards as far as Uganda. It now remained to determine whether definite differences of type exist among the Egyptians from various regions of the Nile valley and among the tribes of the Soudan; also whether the Coptic (pre-Mohammedan) people noticeably differ from the general Moslem population of Egypt. Before publishing the results of this inquiry, the permission of the Sirdar has to be obtained. The material collected will supply the necessary data to permit of the preparation of a report on the physical efficiency of the Egyptian Army.—The Hon. John Abercromby read a paper on the oldest Bronze-age ceramic type in Britain; its close analogies on the Rhine; its probable origin in Central Europe. The oldest type of pottery in Britain is the "drinking cup," for which it is proposed to substitute the shorter term "beaker." Fifty-three of Thurman's three types were shown. Twenty-five interments were described in which the beaker was accompanied by ancient objects; three with large flint daggers, three with buttons with the **V**-shaped perforation below and five with stone wrist-guards, all of which objects belong to the later Neolithic period on the con-

tinent. None of the objects found with the remaining fourteen interments are of later date than the thin, flat, broad knife-dagger. As no other ceramic type in Britain can show such a pedigree, it is clear that the beaker is the oldest, though before it died out several other types of fictilia came into use.

Royal Meteorological Society, November 19.—Mr. W. H. Dines, president, in the chair.—Mr. F. Campbell Bayard read a paper on English climatology, 1881–1900, which was a discussion of the climatological data printed in the *Meteorological Record* from the forty stations of the Royal Meteorological Society, which have been continuous for the whole of the twenty years. The elements dealt with by the author are:—(1) temperature at 9 a.m.; (2) mean minimum temperature; (3) mean maximum temperature; (4) relative humidity; (5) amount of cloud; (6) rainfall; and (7) number of rainy days. The results form a valuable contribution to the climatology of the British Isles.—A paper by Mr. C. V. Bellamy, on the rainfall of Dominica, was also read. This was in continuation of a former paper on the subject, and dealt with all the available rainfall data for the Island of Dominica. From this it appears that the mean annual rainfall of the island is 110 inches. In the neighbouring island of Montserrat, a remarkably heavy rainfall occurred during the night of November 28–29, 1896, when as much as 20·13 inches fell in the space of six or eight hours.

Cambridge.

Philosophical Society, November 10.—Dr. Baker, president, in the chair.—Notes on a vibration magnetometer, and on the ball-ended magnets of Robison, by Mr. G. F. C. Searle. The comparison of the horizontal components of magnetic fields by the method of vibrations presents no difficulty when each field is so nearly uniform that a vibrating magnet several centimetres in length may be used. But when the fields are far from being uniform, the magnet must be quite short. The magnet must in any case be slender, for unless its length be at least ten times its diameter, the magnetic moment varies appreciably when the field varies, even for fields comparable with that of the earth. A simple magnet 1·5 cm. in length and 0·15 cm. in diameter is in many ways practically inefficient. In the vibration magnetometer exhibited to the Society, the magnet is 1·5 cm. in length and 0·15 cm. in diameter. The time of vibration is increased from 1·4 to 6·3 seconds by attaching the magnet to a pointed plumb-bob the mass of which is about fifty times greater than that of the magnet. The bob also carries an aluminium pointer to magnify the motion; this enables the time of vibration to be very exactly determined. Ball-ended magnets were devised by Prof. John Robison, of Edinburgh, about 1770; the author was led, independently, to the same design.—On cavitation in liquids, and its occurrence in lubrication, by Mr. S. Skinner. If water is run into the space between two lenses, arranged so as to show Newton's rings, and if one of the lenses is rolled on the other, a crescent-shaped cavity is developed when the velocity of rolling exceeds a certain critical value. The cavity fills as soon as the rolling ceases. With more viscous liquids, such as lubricating oils or glycerine, the formation of the cavity is more marked. With colourless liquids, the production of the cavity is observed by taking advantage of total internal reflection or by using sodium light and observing the Newtonian rings formed in the cavity. With deeply coloured liquids, the effect may be observed by transmitted light. Instantaneous photographs have been obtained of the effects with lenses rolling on planes, lenses sliding on planes and in some other cases. The effects are shown to agree with Osborne Reynolds's theory of the viscous origin of friction when copiously lubricated surfaces move over one another (*Phil. Trans.* A, 1886). That the maximum negative pressure occurs at some distance from the point of nearest approach is confirmed by these observations, and it appears that the layer of lubricant which separates the surfaces at the point of nearest approach is thinner than the wave-length of sodium light. Cavities of the same character probably occur in all sufficiently lubricated bearings.—On the coral reefs of Pemba Island and British East Africa, by Mr. C. Crossland. The paper shows that the island of Pemba, though very similar in structure to that of Zanzibar, is of separate origin to the mainland, whereas the latter island is a part of the mainland barrier system. The fringing reef of the east coast of Pemba represents an early stage in the formation of that of Zanzibar, while a barrier reef, also a result of erosion, not of growth, encloses large bays on the west coast which are comparable to the lagoon of the Bermuda atoll. The mainland of East Africa is bordered by both fringing and barrier reefs, both of which are formed entirely of dead rock, in which physical agencies have in some cases produced miniature atolls. Wherever growing coral occurs in the East African region, it is seen that the physical conditions (*e.g.* the absence of big waves) are not such as to allow the formation of typical reefs. Finally, some observations on the conditions favourable to coral growth were given, which conditions are present round an oceanic atoll to a much greater degree than near a continental area.—On the theory of aggregates, by Mr. A. N. Whitehead.

Paris.

Academy of Sciences, November 24.—M. Albert Gaudry in the chair.—The velocity of light and the solar parallax, by M. Perrotin. An account of experiments at the Observatory of Nice on the velocity of light. Fizeau's method was used, the total distance traversed by the light being 92 kilometres. As the emission telescope, the 72 cm. objective of the Observatory was utilised, with a 38 cm. objective as collimator. The mean result of 1109 observations was 299,860 kilometres per second in a vacuum. By combining this with the observations on the planet Eros, from which a value of 8″·805 was deduced for the solar parallax, the coefficient of annual aberration was found to be 20″·465, the exact number adopted by the International Astronomical Conference of 1896 at the instance of MM. Lœwy and Newcomb.—On the origin and geographical dispersion of *Lagomys corsicanus*, by M. Ch. Depéret.—Report on the work accomplished by the Brazilian Commission, under the direction of M. Cruls, on the exploration of the principal sources of the Javary, and for the determination of the geographical co-ordinates of several points in this region at points common to Peru, Brazil and Bolivia, by M. Lœwy.—Observations of the sun made at the Observatory of Lyons with the Brunner 16 cm. equatorial during the third quarter of 1902, by M. J. Guillaume. Tables are given showing the number of spots, their distribution in latitude and the distribution of the faculæ in latitude.—On monodrome functions with an isolated essential singular point, by M. Edmond Maillet.—On an extension of the notion of periodicity, by M. E. Esclangon.—On an automatic carburettor for explosion motors, by M. A. Krebs. A theoretical investigation as to the manner in which the area of the orifice air should vary with the pressure of the air and the height of the petrol in the reservoir. Following the indications thus obtained, an apparatus has been constructed in which these conditions are fulfilled, and it has been found that the velocity of the motor can be varied suddenly between very wide limits, an absolutely constant gas mixture being obtained.—On the construction of electrodiapasons with long variable periods, by M. E. Mercadier.—On the ionisation of a salt flame, by M. Georges Moreau. The ionisation of the salt flame was found to decrease according to an exponential function of the distance between the electrodes, and the conclusion is drawn that the unipolar conductivity of a saline vapour is analogous to that of a mass of hydrogen surrounding an incandescent carbon filament, or that of a gaseous mass in contact with a metal illuminated by ultra-violet radiations.—Some observations on uranous oxide, by M. Œchsner de Coninck. Uranyl bromide, ignited in a current of air, loses its bromine, thus differing from the behaviour of the corresponding chloride.—On the combinations of the complex cyanides with fatty amines, by M. P. Chrétien. A study of the salts obtained by the action of hydroferrocyanic acid upon the primary iso-amylamines.—A method for the estimation of glycerol in wine, by M. A. Trillat. The method is based upon the solvent powers of pure acetic ether for glycerol. The glycerol extracted is much purer than that obtained by the usual alcohol-ether method.—On the structure of the muscles of *Anomia ephippium*, by M. Jobert.—On some new or slightly known forms of Rhabditis, by M. Aug. Michel.—The theory of phytons in Gymnosperms, by M. G. Chauveaud.—On the mode of vegetation and reproduction of *Amylomyces Rouxii*, the fungus of Chinese yeast, by M. J. Turquet.—The actual production of native sulphur in the subsoil of the Place de la République, in Paris, by M. Stanisla, Meunier. In the course of the excavations for a railway tunnels native crystallised sulphur has been found in a black clay. Reasons are given for supposing that this deposit has been formed during the last two centuries.—On the general theory of the action of some diastases, by M. Victor Henri. Two hypotheses are examined; supposing that a portion of the ferment

combines with a part of the body undergoing hydrolysis, another part combining with a portion of the products of hydrolysis. It may be supposed either that it is the non-combined part of the ferment which acts upon the bodies to be split up, or, on the other hand, that the unstable compound formed is itself decomposed, regenerating a part of the ferment. It is remarkable that both these hypotheses lead to the same law. Experiments are given showing the action of invertin upon saccharose alone and mixed with invert sugar, and of emulsin upon salicin.

NEW SOUTH WALES.

Royal Society, October 8.—Prof. Warren, president, in the chair.—Occurrence of the mineral gadolinite at Cooglegong, Pilbarra District, West Australia, by Mr. Bernard F. Davis.—Pot experiments to determine the limits of endurance of different farm crops for certain injurious substances, part i. (wheat), by Mr. F. B. Guthrie and Mr. R. Helms. The authors describe experiments to test the effect upon the growth of the wheat-plant of certain substances occasionally found in the soil and in manures, and known when present in excessive quantities to act as plant poisons. The following table summarises the principal results obtained.

Effect upon germination and subsequent growth of wheat of different percentages of injurious substance in the soil.

	Germination affected.	Germination prevented.	Growth affected.	Growth prevented.
NaCl	0·05	0·20	0·05 to 0·15 (recovered)	0·20
N_2CO_3	0·30	0·5 to 1·0	0·10	0·40
NH_4CNS	0·005	0·01	0·001	0·005
$NaClO_3$	above 0·01	0·05	0·001	0·003
As_2O_3	0·05	0·50	0·05	0·10

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 4.

ROYAL SOCIETY, at 4.30.—(1) On the "Blaze-Currents" of the Incubated Hen's Egg; (2) On the "Blaze-Currents" of the Crystalline Lens: Dr. A. D. Waller, F.R.S.—A Contribution to the Question of "Blaze-Currents": Dr. A. Durig.—On the Similarity of the Short Period Pressure Variation over Large Areas: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—Isomeric Change in Benzene Derivatives. The Interchange of Halogen and Hydroxyl in Benzenediazonium Hydroxides: Dr. K. J. P. Orton.—On the Vibrations and Stability of a Gravitating Planet: J. H. Jeans.

LINNEAN SOCIETY, at 8.—New and rare Corals from Funafuti: G. C. Bourne.—On the Morphology of the Flowers and Fruits of the Xylosteum Section of Lonicera: E. A. Newell Arber.—Note on *Carex Tolomiei*, Boott: B. Clarke, F.R.S.—New and old Phalangidæ from the Indian Peninsula: C. With.

RÖNTGEN SOCIETY, at 8.30.—An Observation bearing upon the Therapeutic Action of the Focus Tube: Dr. D. Walsh.—X-Rays in Ophthalmic Work: Stephen Mayou.—Mr. Isenthal will show the Nodon Electric Valve for converting Alternating into Continuous Current.

CHEMICAL SOCIETY, at 8.—The Absorption Spectra of Metallic Nitrates. Part II.: W. N. Hartley.—The Specific Heats of Liquids: H. Crompton.—(1) Studies in the Camphane Series. Part X. The Constitution of Enolic Benzoylcamphor; (2) Note on the Isomeric Benzoyl Derivatives from Isonitrosocamphor: M. O. Forster.—The Constitution of the Products of Nitration of Meta-acetoluidide: J. B. Cohen and H. D. Dakin.

AËRONAUTICAL SOCIETY, at 8.—Presidential Address. Recent Aëronautical Progress: Major B. F. S. Baden-Powell.—The Contributions of Balloon Investigations to Meteorology: Dr. W. N. Shaw, F.R.S.—The Kite Equipment of the Scottish National Antarctic Expedition: John Anderson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Extra Meeting for the Inaugural Address by the President, Mr. J. Swinburne.

FRIDAY, DECEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Erection of Steel Bridges, Sheffield Extension of the London and North-Western Railway: A. Reynolds.

GEOLOGISTS' ASSOCIATION, at 8.—On the Formation of Chert: Miss Catherine A. Raisin. Illustrated by Lantern Slides.—A List of the Fish Remains from the Middle Bagshot Beds of the London Basin: A. K. Coomaraswamy.

SATURDAY, DECEMBER 6.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30.—The Non-Marine Mollusca of the River Lea Alluvium at Wathamstow: A. S. Kennard and B. B. Woodward.—Demonstration of the Lumière Process of Colour Photography and its applications to Natural History Work: Edward R. Turner.

MONDAY, DECEMBER 8.

SOCIETY OF ARTS, at 8.—The Future of Coal Gas and Allied Illuminants: Prof. V. B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Three Years' Exploring Work in Central Asia: Dr. Sven Hedin.

TUESDAY, DECEMBER 9.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion of paper on* High-Speed Electrical Generating Plant: T. H. Minshall.

WEDNESDAY, DECEMBER 10.

SOCIETY OF ARTS, at 8.—French Rural Education and its Lessons for England: Cloudesley Brereton.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—On Certain Properties of the Alloys of the Gold-Silver Series: The late Sir William Roberts-Austen, F.R.S., and Dr. T. K. Rose.—Abnormal Changes in some Lines in the Spectrum of Lithium: H. Ramage.—An Error in the Estimation of the Specific Gravity of the Blood by Hammerschlag's Method, when Employed in Connection with Hydrometers: Dr. A. G. Levy.—Quaternions and Projective Geometry: Prof. C. J. Joly.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Photometry of Electric Lamps: Dr. J. A. Fleming, F.R.S.

SOCIETY OF ARTS, at 4.30.—Domestic Life in Persia: Miss Ella C. Sykes.

INSTITUTE OF ACTUARIES, at 5.30.—Lecture on Statistics (Measurement of Groups): A. L. Bowley.

MATHEMATICAL SOCIETY, at 5.30.—Application of Matrix Notation to the Solution of Linear Differential Equations: Dr. H. F. Baker.—The Expression of the Double Zeta and Gamma Functions in Terms of Elliptic Functions: G. H. Hardy.—Sets of Intervals. Part II., Overlapping Intervals: W. H. Young.—Series connected with the Enumeration of Partitions: Rev. F. H. Jackson.—The Abstract Group simply Isomorphic with the Group of Linear Fractional Transformations in a Galois Field.

FRIDAY, DECEMBER 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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THURSDAY, DECEMBER 11, 1902.

COOPERATION AMONG INSTRUMENT MAKERS.

L'Industrie Française des Instruments de Précision. Catalogue publie par le Syndicat des Constructeurs en Instruments d'Optique et de Précision.

Microscopes and Microscopical Accessories. Carl Zeiss, Jena; *Physical Apparatus*, Max Kohl, Chemnitz; *Physikalische Apparate*, Ferdinand Ernecke.

THE German catalogue of scientific apparatus at the Paris Exhibition has been frequently mentioned in the pages of NATURE, and its value to students of physics has been noted.

The first work under review in the present article is a consequence of its publication. It is a catalogue of French apparatus of great interest in itself and of real value to the man of science in that it enables him to obtain information in a small compass as to instruments of French construction.

The arrangement differs in some respects from that of the German catalogue, on which it is avowedly based. The object of the latter was to give a complete view of German trade and manufacture; hence the catalogue was arranged in subjects, the apparatus in each subject being grouped under the makers' names; the French catalogue is arranged alphabetically under the makers' names. An index "Table des Specialités" enables the reader to find out readily which of the numerous firms in the catalogue make any special class of apparatus and to refer to the descriptions of their products. For most purposes, the German plan seems more convenient. For a man wishing to buy a spectroscope, it is simpler to have all the spectroscopes grouped together; the plan, however, does not serve to call marked attention to the whole output of any one large firm, and it is natural for a society of instrument makers to arrange their joint catalogue according to the French pattern.

It is not easy in a review to give a full account of the catalogue; it covers some 270 quarto pages, it is clearly printed and well illustrated. The long list of names it contains reminds us what science owes to the skill and workmanship of French mechanicians; it is impossible to turn over the pages without recognising names which are honourably known wherever science has penetrated, and apparatus which has aided and rendered possible some of its greatest discoveries. One name we miss, that of R. König, now no longer with us, who will live, through his acoustical apparatus, as a genius of construction.

The introduction by Cornu, which must have been one of his last pieces of work, adds to the value of the book. M. Cornu gives an interesting history of the development of scientific instruments in France, and of the close alliance between the man of science and the instrument maker from early times up to the present day, and then, noting how instruments of precision have become part of one's daily life, draws attention to the necessity for continued close connection between science and the commercial side of an industry if that industry is to flourish.

The example of Germany has lessons for France as well as for us in England, and mechanical tools introduced in America have become a necessity in French workshops no less than in English. The French instrument-making industry feared for a moment a dangerous rivalry and the diminution of its own trade through the advance of new comers proclaiming themselves so fully equipped.

The catalogue is in part the outcome of this; it helps to show, as M. Cornu claims, that the French industry has nothing to fear from its foreign rivals.

"To complete its successful preparation for the struggle, it is only necessary to adopt, in addition to what it has done, the powerful weapons of association and discipline —a discipline voluntarily accepted in view of general interests; then an intelligent union will lead all efforts to converge towards one common end instead of wasting them in those barren struggles which the thirst after immediate interests provokes in short-sighted minds."

We in England have no Association of Instrument Makers and no catalogue of instruments of precision. The Optical Society, it is true, is doing its best to strengthen the position of opticians, but it is far from covering the whole field.

Does not the fact that our French colleagues have followed the example set by Germany give us food for reflection, and lead us to inquire whether association and discipline might not be helpful to us also?

And this query is pressed home by three recent catalogues of scientific apparatus which have been issued by German firms; the first in English, the second in English, French and German, the third in German. Messrs. Zeiss's list deals with their microscopes, and is most complete. As usual with their lists, it is fully illustrated, while the information about the instruments is given in a convenient form. Details as to the lenses are tabulated, and it is easy to select the particular combination of object-glass and eyepiece most suitable for any desired end. The set of apochromatic objectives is very complete; lenses of 2 and 3 mm. focus and 1·4 numerical aperture are on the market; these, it is stated, are made of permanent glass. The list is an object lesson of the results technical art and skill can produce when resting on a basis of sound scientific investigation.

Messrs. Max Kohl, whose agents in this country are Messrs. Isenthal and Co., have issued a catalogue of nearly 700 pages. They supply almost everything required for teaching purposes in a physical laboratory. Their goods are well known, and the list affords striking evidence of the progress of science in education, in Germany at any rate, if not here. Much of the apparatus is extremely well arranged for the purpose for which it is designed, and the list is one which is sure to be of value in every physical laboratory.

Messrs. Ernecke's catalogue contains an account of their goods, with illustrations of a high class. Though smaller than that of Max Kohl, it commands attention by the wide range covered and the general excellence of the get up. Lists such as the above must prove of advantage to German trade in all countries of the world and be powerful aids in international competition. Their convenience is obvious. We in England specialise more; we go to one firm for resistance boxes, to another for

telescopes, and have nothing exactly corresponding to a vast emporium such as that of Max Kohl. All the more reason, therefore, for the association and discipline urged on his French colleagues and co-workers by Cornu.

R. T. G.

AMERICAN FOOD AND GAME FISHES.

American Food and Game Fishes: a Popular Account of all the Species found in America North of the Equator, with Keys for Ready Identification, Life Histories and Methods of Capture. By David Starr Jordan and Barton Warren Evermann. Pp. l + 573; illustrated with coloured plates and text drawings, and with photographs from life. (London: Hutchinson and Co., 1902.)

DRS. JORDAN AND EVERMANN, who have recently enriched science by the publication, under the auspices of the Smithsonian Institution, of a great work in four volumes describing in detail the 3300 species of fishes distinguished by them in North and Central America, reviewed not long ago in the columns of NATURE, have now prepared another book, intended to

"furnish that which well-informed men and women, and those who desire to become well informed, might wish to know of the food and game fishes which inhabit American waters."

This book, teeming with interest from the full accounts, presented in a charming manner, of the habits, distribution and uses of the more important forms from the point of view of the angler, has been lavishly got up in America. The coloured pictures, as well as the photographs taken from life with marvellous success by Mr. A. Radclyffe Dugmore, could not be surpassed in excellence, and the numerous "process-blocks" which have already appeared in various American publications will, thanks to the perfect accuracy with which the fishes have been delineated, greatly facilitate identifications. Authors and publishers are to be congratulated on the production of such a book, which will undoubtedly have the effect of enlisting a more scientific interest in fishes on the part of many who have hitherto looked upon them as mere objects of sport or curiosity, and to whom the use of the more technical treatises on the subject would be distasteful. In deference to such readers, the systematic aspect has been reduced to the narrowest limits that appear compatible with the proper recognition of the numerous genera and species dealt with. It is to be hoped that not a few whose interest is sure to be awakened by a perusal of this charming book will later turn to the more technical work by the same authors, and improve their knowledge through a study of the relationships existing between the various families of fishes, which are here merely defined without any allusion to the higher groups into which they fall.

American taxonomists have always shown a particular predilection for reducing all divisions of the system to the narrowest possible limits. This tendency is carried to the extreme by Messrs. Jordan and Evermann, who inform us in the introduction that not only the lampreys and hags are to be excluded from the class Pisces, but also the sharks and rays, the lung-fishes and Polypterus, which they regard as only fish-like creatures, fishes in the broad sense of the term, but not "true fishes," and are therefore excluded from the work. Ganoids, on the other hand, are still maintained among fishes proper. In conformity with this method of excessive multiplication of systematic divisions of all grades, the various forms of Salmonidæ which are usually regarded as subspecies, such as the land-locked salmon and the varieties of *Salmo clarkii*, *gairdneri* and *fontinalis*, are all dealt with as distinct species—twenty-six species instead of the four admitted by the same authors in their previous work. True, a few pages before, the authors pertinently remark that

"The non-migratory species (subgenus Trutta) occur in both continents, are extremely closely related and difficult to distinguish, if, indeed, all be not necessarily regarded as forms of a single exceedingly unstable and variable species. The excessive variations in colour and form have given rise to a host of nominal species. European writers have described numerous hybrids among the various species of Salmo, real or nominal, found in their waters. We have thus far failed to find the slightest evidence of any hybridism among American Salmonidæ in a state of nature. Puzzling aberrant or intermediate individuals certainly occur, but such are not necessarily hybrids."

Bearing in mind the authors' tendency to excessive multiplication of species and higher divisions, it is not a little surprising to read in the introduction that the "true fishes" of the whole world are estimated at only 12,000 species, arranged in about 200 families. A careful computation which has recently been made by the reviewer, applying somewhat different canons of classification, has resulted in numbers that are not very different, viz. 11,200 for the species and 160 for the families. The number of species in the American authors' estimate is even far below that given in the article "Ichthyology" in the supplementary volumes of the "Encyclopædia Britannica," viz. 17,000.

The usefulness of the work is enhanced by special chapters on the external characters of fishes from the descriptive point of view, on fly-fishing (by Mr. E. J. Keyser), a glossary of technical terms, and an artificial key to the families of American food and game fishes.

The copy received for review bears the mark of a London publishing firm. But the identical book was issued in May last by Messrs. Doubleday, Page and Co., at New York.

G. A. B.

HUMAN ANATOMY.

Text-Book of Anatomy. Edited by D. J. Cunningham, F.R.S. Pp. xxix + 1309; 824 wood engravings from original drawings. (Edinburgh: Pentland, 1902.)

AT the present time the human anatomist tries to sit as comfortably as he may on the two stools of science and practice. It must be admitted that few do it with success. While his posture evokes the indulgent smile of the man of science, the professed zoologist and morphologist, the man of practice, the surgeon and physician, regards it as altogether unprofitable and impracticable. To reconcile the views of these two contending factions, to make the theory of anatomy assist in its practical application to the sick and the facts of

anatomy illumine the laws of mammalian morphology, is the first and chief difficulty of anyone who now or afterwards undertakes the preparation of a text-book on human anatomy. No living anatomist is likely to be more successful in overcoming this difficulty than Prof. D. J. Cunningham, who is deservedly held in the highest esteem by the surgeon and physician, as well as by the man of science. While admitting that Prof. Cunningham has been more successful than any one of his predecessors, one rises from the study of this work with the feeling that, in spite of rapid improvement, it will take decades of progress to make the theory of anatomy fit its facts as a glove does the hand.

Not a single decade has passed during the last two centuries without someone proclaiming from the house-tops that at last the whole field of human anatomy is explored and finished, and yet the annual output of new research has continually increased. The manner in which this work is produced is evidence of the rapid growth of the subject. It is no longer possible for one man to be intimately acquainted with the more recent work or to supply first-hand information in each of the many departments into which human anatomy has been subdivided, and hence the necessity for a collective effort. Works of reference like the English Quain, the French Poirier, the German Bardeleben, necessarily demand the combined services of specialists, but here, even in a work designed to meet the needs of candidates for a pass degree, the same necessity has been felt. The editor has been fortunate in the selection of his collaborators. To Prof. Young, of Owens College, and Prof. Robinson, of King's College, London, have been assigned the sections on embryology and the vascular system; to Prof. Thomson, of Oxford, that on osteology; to Prof. Paterson, of Liverpool, the muscular and nerve systems; to Dr. Hepburn, of Edinburgh University, the section on joints; to Prof. Howden, of Durham University, the section on the organs of special sense; to Prof. Birmingham, of Dublin, the organs of digestion; to Prof. Dixon, of Cardiff, the urinogenital system; to Dr. Stiles, the section on surgical anatomy; while the editor himself undertook the central nervous system. It may be said at once that each contributor has given, not only the best that is known, but has also made original contributions to his particular section. Some of the sections, such as those on the nervous system, the alimentary system and embryology, gave their authors a greater opportunity than did others, and these opportunities have not in any single case been allowed to slip by.

There is a unity in the work which may be explained by the fact that all the contributors, with one exception, are pupils of the veteran leader of the Edinburgh anatomists, Sir William Turner, to whom the book is most worthily dedicated. This work has all the merits and also all the defects of the Edinburgh school. There are the full and lucid descriptions of the important things, but there is also an over-strenuous endeavour to be thorough by the introduction of masses of unimportant or irrelevant detail. Turn, for instance, to the description of the spermatozoon, and it will be found that the medical student is expected to master more than fifty details concerning its structure; or turn to the descriptions of a bone, a muscle or an artery, and the same crowding of detail will be found. A student who thoroughly prepares himself from this work will present himself to his examiners loaded with more than 60,000 anatomical facts, 75 per cent. of which will appeal to his memory more than to his intelligence, and only a small percentage of which will be of use to him in the practice of his profession. It is a primary defect of the Edinburgh school that, owing to its detachment from the hospitals, it has come to regard the study of anatomy as an end in itself instead of being only the scaffolding on which a student has to lay his knowledge of physiology. On the combined basis of anatomy and physiology he has subsequently to build his knowledge of pathology, surgery and medicine, and all the efforts of the anatomist and physiologist must be bent so as to reach this end. The student, when he comes to build out his mental picture of the circulation, respiration and locomotion of the human body, will find that this work will afford scarcely a better anatomical scaffolding than older and less complete works.

One feels that Prof. Cunningham has let slip an opportunity that occurs to a man only once in a century. With such a powerful syndicate of anatomists behind him he could have disregarded the prejudices of examiners, relegated thousands of useless anatomical details to the limbo of oblivion and made his subject once again live. That he has not done so shows that the principle on which present systems of anatomy are designed meets with his deliberate approval, and it is on those broad lines that most thinking men will join issue with him.

During his study of this work the reviewer has laid it side by side with Bell's "Anatomy," another triumph of the Edinburgh school, but of a century ago. The opinion has been forced on him that the design of the older book is the better of the two. All through Bell's pages, in spite of some crude theories, inaccurate facts and passing personalities, anatomy is made to coquet with physiology and morphology, and all three are invariably made to serve as handmaidens to the surgeon and physician. The ideal treatise of human anatomy will be produced by the man who accepts the principles of the anatomists of the beginning of last century and applies them to the facts at the disposal of anatomists at the beginning of the present one.

The illustrations of this work are all well designed and artistically finished, but the poorness of its binding and its narrow margins, which give it a general appearance of meanness, are out of keeping with the high standard of its contents and the artistic demands of the present day medical student.

A. KEITH.

DIFFERENTIAL CALCULUS FOR BEGINNERS.

Differential Calculus for Beginners. By Alfred Lodge, M.A., with an Introduction by Sir Oliver J. Lodge, D.Sc., F.R.S., LL.D., Principal of the University of Birmingham. Pp. xxv + 278. (London: George Bell and Sons, 1902.) Price 4*s*. 6*d*.

PROF. ALFRED LODGE is so well known among mathematicians as an authority on the teaching of geometry and kindred subjects that the addition of his brother's name to the title-page may appear superfluous.

The introduction by the latter contains a brief statement of the uses and purposes, not only of the differential calculus, but also of the integral calculus and of differential equations. The present volume, however, deals exclusively with the differential calculus, and that only so far as it refers to functions of one and two variables. A notable and important exception to this limitation, however, occurs in the chapter on successive differentiation, where the notion of $D^n y$ naturally leads to that of $D^{-n}y$, in other words, the nth integral of y. Here, however, the notation D^{-n} is alone used, the familiar "F-hole of a violin" being conspicuous by its absence. Probably the latter symbol might advantageously be eliminated from our mathematical notation altogether, were it not for the important difference between differentiation and integration introduced by the appearance of the inevitable "constant of integration" which leads to the further notion of "definite integrals."

The amount of attention given to graphs will be welcomed by the great majority of teachers, and chapter vi., which deals with the application of graphic methods to the approximate solution of equations, is an important feature which ought certainly to occur at some stage or other of an ordinary mathematical curriculum, and may probably be inserted here quite as well as elsewhere. The feature which is most calculated to arouse criticism is the adoption of the method of differentials as the basis of the whole work. The author states that he has found this method most useful and helpful to the student of physics and mechanics, but it has the great disadvantage of throwing into the background something which is very important, namely, the notion of a limit. In examinations there has recently been a tendency on the part of candidates, when asked to find from first principles the differential coefficient of sin x, to send up the following answer :—

$$\frac{d(\sin x)}{dx} = \frac{\sin(x+dx) - \sin x}{dx} = \frac{\sin x + dx\cos x - \sin x}{dx}$$
$$= \frac{dx \cos x}{dx} = \cos x.$$

Even this might be excused if the candidates showed an intelligent appreciation of the meaning of what they were writing down, but as soon as they are asked to differentiate x^x, log sin x, or anything which is not in the book, they exhibit hopeless ignorance, thereby proving conclusively that the stock differentiations have been merely written down by rote.

There is no doubt a tendency on the part of another class of writer to rush to the opposite extreme by making the student read long discussions on continuity before introducing him to the notation of the calculus. But cannot a happy mean be found by introducing the notions implied in the relation $dy = f'(x)dx$ *immediately after* the principal algebraic and transcendental functions have been differentiated by means of the method of limits? Apart from this matter of opinion the book appears to be excellent.

We are glad to see the author does not relegate Taylor's and Maclaurin's theorems to the end of the book. In a logical treatment, that might possibly be their proper position, but the postponement would prevent many readers from acquiring an intimate familiarity of what are probably the most important theorems in the whole of the calculus. G. H. B.

GALL-INSECTS.

Monographie des Cynipides d'Europe et d'Algérie. By l'Abbé J. J. Kieffer. Vol. I. Ibalynæ et Cynipinæ. With 27 plates. Pp. vii + 687. (Paris: Hermann, 1897–1901.) Price fr. 40.

THE present work is a portion of the great series of monographs commenced by the late E. André, under the title of "Spécies des Hymenoptères d'Europe et d'Algérie," by himself, his brother and other specialists, among whom are the Rev. T. A. Marshall and the Abbé Kieffer. The character of the work is well known to all hymenopterists, and in this regard we need only say that another volume will complete the Cynipidæ, including the parasitic subfamilies Allotriinæ, Eucoilinæ and Figitinæ, and will also include the families Evaniidæ, Stephanidæ and Trigonalidæ, and full systematic and synonymic catalogues and indices to both volumes, the first volume containing only an index of families and genera, and a table of contents.

In addition to the systematic portion of the work, the structure, metamorphoses, broods, galls, parasites, biology, bibliography, classification, geographical distribution, &c., of the Cynipidæ are discussed at considerable length; and the author mentions in his preface that though, when he undertook this work in 1896, few or no Cynipidæ were known from any of the more southern countries of Europe or from Algeria, he has now obtained, through the kindness of various contributors whom he mentions, considerable information on these countries, though much of it reached him too late for the first volume and will have to be deferred to the supplement in vol. ii.

Notwithstanding the insignificant appearance of the Cynipidæ, on which the Abbé remarks, they are of extreme scientific interest on account of the alternations which the various broods present of winged and wingless, and sexual and sexless, individuals at different times of the year, in which respect they have much resemblance to the Aphidæ, though the Cynipidæ, unlike the latter, are seldom or never to be regarded as destructive insects, one reason for which may be that the Cynipidæ (or at least certain species) are liable to the attacks of an inordinate number of small parasitic Hymenoptera, chiefly belonging to the Chalcididæ, so that an entomologist may breed a great variety of Hymenoptera from (say) a large quantity of galls of *Cynips kollari*, without obtaining a single specimen of the original species which formed the galls.

Although the insects themselves are inconspicuous, their galls are conspicuous enough, and some of the large fleshy eastern galls on oaks, such as the Apple of Sodom, resemble brightly-coloured fruit; while the moss-like galls, such as the bedeguar on the wild rose, are likewise very pretty objects. One peculiarity of these insects is that a considerable number of the species are attached either to oaks or roses, though some few are met with on other trees. They are also among the few insects which yield products of great value to the human race, the most important of which, of course, is ink; but various galls have been, or are still, used for illumination, for tanning, in medicine, for chemical purposes, and in the case of a few species, even for food.

Though some of our earlier hymenopterists, such as

Haliday and Walker, paid some attention to Cynipidæ, others, such as Stephens and Smith, almost entirely neglected them; and it was not until Mr. P. Cameron published vols. iii. and iv. of his "Monograph of the British Phytophagous Hymenoptera" that we had a satisfactory account of our British species. On the continent, more had been done by Mayr, Adler and others, and now the Abbé Kieffer has furnished us with a full account of the European and Algerian species of these interesting but still somewhat neglected insects; and although every monograph or catalogue always helps to make itself incomplete by stimulating the activity of all observers who are sufficiently interested in the subject to take up or to continue the study, yet the book may reasonably be expected to hold its place as the leading authority on the subject for many years to come. W. F. K.

OUR BOOK SHELF.

Chemisches Praktikum. 1 Teil. Analytische Übungen. By Dr. A. Wolfrum. Pp. xviii + 562. (Leipzig: W. Engelmann, 1902.) Price 10*s.* net.

The object of the author is to present a course of practical instruction in analytical chemistry on a technical basis. It is intended that the student shall be confronted throughout his course of work with the technical application of the principles and methods which he makes use of in the laboratory. The author hopes by this means to improve the training of the student whose aims are directed towards chemical work in the arts and manufactures.

The subject-matter is divided into three sections, under the headings qualitative, quantitative and technical analysis. In the first section, the ordinary reactions of the metals and acids are given, ionic nomenclature being employed. The rare metals are dismissed by a consideration of thorium and cerium, these alone in the author's opinion being of sufficient technical importance to merit discussion. The qualitative analysis of organic substances is then treated, the reactions for the most important organic radicals being given. The section concludes with a long list of important organic compounds for which the special tests are given, as well as directions for ascertaining the presence of the most frequently occurring impurities.

In the section on quantitative analysis, the order of treatment is, gravimetric estimation of the metals and acids, elementary analysis of organic compounds, volumetric analysis and estimation of the most important atomic groups of organic compounds. Twenty pages are devoted to the methods of determining molecular weights of organic compounds and fifteen to gas analysis, but, singularly enough, not a single diagram is appended to illustrate the special apparatus used in operations with gases.

Under technical analysis, which forms the subject of the last 200 pages, is discussed the analysis of water, fuels, ores and metallurgical products, products of the chemical manufacturing industries, artificial mineral colouring matters, artificial manures, lime, cement, clay, raw materials and products of the sugar industry, ethereal oils, aniline colours and products used in the manufacture of these colours.

The book, as will be seen, contains a wealth of material. It is doubtful, however, whether such a work could be placed with good results in the hands of the average student of chemistry. The amount of material accumulated by the author within such a small compass is so great that the efficiency of the book as a working guide for the student must necessarily suffer. All experienced teachers are aware that a book which the average student is to use in his daily work in the laboratory must contain full working details, and the "Chemisches Praktikum" does not.

As a reference book, however, it will without doubt be found very useful in the laboratory, and for such a purpose can be warmly recommended. H. M. D.

The Coal-fields of Scotland. By Robert W. Dron. Pp. vi + 368. (London: Blackie and Son, Ltd.) Price 15*s.* net.

Numerous descriptions have been published of the Scottish coal-fields from the time of Ball, Milne and Landale to our own day. Most of these, however, have been scattered through the volumes of scientific journals or published in official reports which, as a rule, have been badly printed, expensive, and insufficiently made known to the public. By far the most important contributions to the subject are those to be found in the maps and memoirs of the Geological Survey. These publications contain a storehouse of information; they were the first, and are still the most detailed and complete, review of the whole geological structure of the coal-fields. The maps present a graphic picture of the disposition of the coal-seams and the extent to which they have been dislocated and folded. The memoirs furnish a large amount of information which could not be embodied in the maps, and both taken together form the basis on which all subsequent descriptions must rest. The progress of development has led to the opening of some new fields and to the exhaustion of others, since the appearance of the Survey publications, but we understand that arrangements have been made for an official re-examination of the coal-fields and the preparation of new editions of the maps. The work of the Survey will thus be brought up to date, and will maintain the high position which it has always held.

Without these official maps and memoirs, Mr. Dron could not have produced the volume which he has just published. He acknowledges, in his preface, in a general way that he has freely utilised "all available sources of information, including the publications of the Geological Survey." It would have been well, however, had he made more specific acknowledgment of his obligations. No one who is not familiar with the subject would suspect from his chapters how deep his indebtedness is all through the book. The occasional allusions to the Survey work seem strangely inadequate in comparison with the fulness of his references to private individuals of whose assistance he has availed himself. The maps, for instance, with which he embellishes his book are reduced (not very satisfactorily) from those of the Geological Survey, but there is no reference to the source from which they are derived. The volume, though it has no originality, supplies a convenient summary of what is at present known regarding the coal-fields of Scotland, and may be useful as a popular handbook of the subject.

A Glossary of Popular, Local, and Old-Fashioned Names of British Birds. By C. H. Hett. Pp. vi + 114. (London: H. Sotheran and Co., 1902.) Price 1*s.*

To the last edition of his "Bird Notes," the author appended a glossary of synonyms of the British species. The present little volume is an amplification of that glossary, and appears to be as nearly complete as possible. The work commences with a classified list of the British species (in which we notice that the author is a conservative in the matter of nomenclature), and then follows the glossary. It should enable amateur ornithologists residing in country districts to identify all the local birds without difficulty. R. L.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Suggested Nature of the Phenomena of the Eruption of Mont Pelée on July 9. Observed by the Royal Society Commission.

ALTHOUGH Dr. Anderson and Dr. Flett were able, at the largely attended meeting of the Royal Society on November 20, to add little to what they had published in their preliminary report three months ago, beyond exhibiting the very full and excellent series of photographs of the affected regions of the Soufrière and Mont Pelée eruptions, they succeeded in exciting renewed interest in the problem of the nature of that eruption of Mont Pelée on the evening of July 9, which they had the exceptionally good fortune to witness under most favourable conditions. The photographs and perfect description of this particular outburst give it an unsurpassed value as a contribution to the scientific history of volcanoes, and the Royal Society has therefore the greatest reason to congratulate itself upon the success—a success almost beyond the most sanguine expectation—of its commission to Drs. Anderson and Flett to visit the scene of these eruptions.

We can now hardly hope that any fuller knowledge of the nature of an eruption of the kind witnessed by these geologists will be forthcoming through future observations. What is now to be done in order to clear up what remains obscure is experimental work in the laboratory. To me it seems that only one point requires investigation before we shall have a definite conception and understanding of the phenomenon at the base of such outbursts as those in the West Indies, as well as that of the Bandaisan eruption, or rather explosion, in Japan, closely similar to them in its essential features.

From the text of the published report, modified a little in the accounts given at the meeting, we know that, after spasmodic bursts of steam, dust, and stones, and discharges of torrents of water and mud, the climax of the eruption came as the welling-up in the crater and overflow, like that of a liquid, of red-hot dust, which descended the mountain side, at first relatively slowly, but with ever-increasing velocity, like an avalanche of snow. This avalanche of incandescent sand was accompanied by a dense cloud, black as night, which soon concealed it from view and swelled out in convolutions with terrible energy until it reached perhaps one mile high and two broad. After this, it ceased to enlarge and gradually lost its dense blackness through ash settling down and leaving nothing visible but white steam.

There was, therefore, (1) a flow of incandescent sand down to the sea, mainly by gravitation, but with a velocity apparently surpassing that of a torrent of water; and (2) the expanding motion of the superincumbent, black cloud, together with its rapid motion along the course of the stream of sand, *from which it never lifted.* Just after the overflow of sand from the crater, there must have been an enormous outrush of steam and, perhaps, other gases, and this will have had some effect in driving the cloud through the air; but the progressive formation and the appearance of the cloud forbid the belief that this effect could have been considerable. That the cloud enlarged upwards rather than laterally was due to its consisting of heated steam, for although the dust which it carried with it will have impeded the velocity of its expansion, it will not have lessened its extent.

There can be only one conclusion drawn as to the cause of the free motion and rapid rush of the torrent of sand and of the swelling, convoluting cloud, and that is the continuous evolution of water vapour from every particle of the moving hot sand. Possibly some other gas may also have escaped, but if so only in relatively small quantity, as otherwise the water vapour would not so easily have condensed and become visible. Violent friction between the issuing steam and the solid particles may sufficiently account for the extensive electric discharges. The continuous escape of this water from the particles of the hot sand, at such a high temperature, even though in small quantity, would surround every particle with a compressed atmosphere of steam sufficient to keep it apart from all others, and thus produce a quasi-liquid mass which, on account of the density of the sand, would gravitate strongly and at the same time would, by virtue of the interstitial compressed steam preventing all rubbing together of solid particles, give the mass its marvellous mobility. That this would be so is easily borne out by facts familiar to the chemist and physicist. One of these was, indeed, brought up by Sir William Ramsay in the discussion which followed upon the reading of the papers, namely, the behaviour of precipitated silica when heated, which, however, he attributed to a movement of particles in gases similar to that of Brownian movements of particles in liquids. When any fine dust or powder, which is non-coherent whether cold or hot, gives off sufficiently fast a gas or vapour when heated, it will, when smartly heated, swell up and become mobile, sometimes almost as mobile as liquid ether, keep a horizontal surface when its containing-vessel is tilted, and admit of being poured like a liquid into another vessel. Because of its frequent presence in the work of inorganic chemical analysis, precipitated silica is, perhaps, the most widely known example of this behaviour. In ordinary circumstances, the silica acts in this way almost wholly in consequence of its continuing to liberate up to even a blowpipe heat the water always present in some form of combination with it. Probably, too, it and all such light powders owe for a moment part of the movement of their particles from each other merely to the rapid expansion of the air in the interstices of the powder when the containing vessel is quickly heated, but the escape of hygroscopic or other moisture is obviously the principal cause. When the silica is kept steadily heated, it loses most of its mobility. Other hygroscopic or vapour-condensing powders behave similarly; very finely divided charcoal powder is generally a good example; magnesia alba is another, which gives out both carbonic acid and water.

Light bodies are naturally best fitted for the observance of this phenomenon, but manganese binoxide when evolving oxygen shows it, and even platinum black will throw up dust and enlarge. Indeed, it is a common phenomenon for a slightly coherent powder suddenly heated in a platinum crucible to float in motion as a moulded mass in an atmosphere of gas generated from itself by the hot walls of the crucible. Not inapposite instances of the power of escaping vapour to hold up bodies is that familiar phenomenon of liquid water or alcohol assuming the spheroidal state, that is, rolling about on a hot plate without touching it, being couched on a bed of its own continuously evolved vapour. Where experiment is now wanted is to find out what andesitic minerals will, under great pressure, combine chemically or physically, but intimately, with water at a red out heat and then retain it sufficiently when the pressure is released for an appreciable though short time to elapse before the regeneration of the steam is ended.

A modification of the explanation here given suggests itself which would do away with the necessity for the existence of such combinations of water with rock materials. It is that as the incandescent sand flowed over the soil, it generated the steam from the damp earth or hydrated rocks beneath it in such quantity as to buoy up the sand from the soil and separate its particles. In accordance with this view would be the observation that the hot sand visibly (that is, without obscuring cloud) poured over the lip of the crater and then as it flowed down obscured itself in cloud. On the other hand, the escape of gas or vapour caused by cooling is not an unknown phenomenon, while against this view is the difficulty to explain when holding it the production of the sand within the crater. Drs. Anderson and Flett speak of the dust as lava blown to pieces by the expansion of the gases it contains. I would suggest that the production of the sand just in that way is inconceivable; for if the lava had been molten, it would have been scattered in drops and vesicles in all directions, and only if solid would it have become dust, while in either case it would not have remained as a mass of sand, but have been scattered to the winds. The production of sand or dust, if it really was produced in the crater, will have been a disintegration of rock masses by the pressure diffused through them of the condensed water, with which they were impregnated and perhaps combined, a disintegration leading up to the falling to dust of the masses while they were still under sufficient pressure to prevent scattering.

The strong escape of steam from the sand would, of course, carry up much of the dust with it and thus constitute the black cloud, while its cauliflower-like expansions were apparently only an exaggerated form of what is to be seen over a seething cauldron or a stream of boiling water. EDWARD DIVERS.

November 22.


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The Paradox of the Piano Player.

WHEN a number of notes in different parts of the keyboard of a pianoforte are struck by means of levers actuated by a common pneumatic pressure, it appears to be the universally prevailing belief that the only variations possible are those in which the whole chord is made to sound louder or softer by increasing or decreasing the pressure. It is commonly regarded as an impossibility to vary the *relative* intensities of the sounds produced by the various notes so as to make, *e.g.*, the bass parts sound louder and the treble softer, or *vice versâ*.

On the other hand, dynamical considerations suggest that the intensities of the sounds excited in the different strings of the piano depend, not only on the total pressure applied to the mechanism, but also on the way in which this pressure is made to vary during at least part of the interval from the instant at which the key is first touched to the instant at which the hammer leaves the strings. A short, sharp impulse suddenly cut off should produce its greatest effect on the notes of higher pitch, while a heavy, sustained or increasing pressure should make its effect most marked on the lower notes of the instrument. During the last few months, I have given considerable attention to the practical application of this theory, and the effects which I find it possible to produce, provided that the accentuation is performed at exactly the right instant of time, are most remarkable. The treble or bass parts may be made to stand out in so conspicuous a way as to make it difficult to believe that different notes of the chords are not struck by different human fingers. The matter opens up a wide field of discussion, and suggests considerable possibilities in the way of quantitative laboratory measurements. For the present, it may be sufficient to suggest that those of your readers who possess the new musical instruments of the twentieth century suitable for the purpose should, if they have not already done so, perform the experiment for themselves; they will soon be rewarded by being able to enjoy their music in a way they have never enjoyed it previously. G. H. BRYAN.

Cost of Scientific Education in Germany and England.

I NOTICE, in the issue of NATURE of December 4, that you quote Mr. Holzapfel's letter to the *Times* on the cost of scientific education in Germany and England. Although, unfortunately, there can be no dispute as to the great difference between the fees charged in Germany and in England, I think it right that the fees of King's College should be correctly stated. The sum quoted by Mr. Holzapfel represents the charge made for chemistry and *physics*; for chemistry only it was 34*l.* 18*s.* for the year. I have no knowledge of the amount of instruction which the other son obtained for 7*l.* at Aachen. WALTER SMITH, Secretary.

King's College, London, W.C., December 9.

THE REPRODUCTION OF COLOURS BY PHOTOGRAPHY.

THE services which photography has rendered to science are now well recognised, and its value for purposes both of observation and record is well known and admitted. It is probably not so well known that methods now exist by which not only the form, but the colour, of natural objects can be represented with approximate fidelity. We are fortunate in being able to illustrate this fact by a plate giving some excellent reproductions of birds' eggs, produced under the superintendence of Mr. H. E. Dresser, entirely by photographic methods, and without the intervention of an artist.

There is no need to dwell on the value of such work. For many scientific purposes it is as important to record colour as shape, and if this can be done in a trustworthy manner, a new and useful power is placed at the disposal of the teacher of science and of the writer of scientific books. The difficulty about the three-colour process of photography is that it is extremely difficult to make certain that the colours are reproduced with sufficient accuracy for scientific work. Accuracy enough for pictorial purposes is easily attained, but absolute truth to nature is quite another thing. The reasons for this are various. The photographic gradation of light intensities, in the case of both white light and of its various components, is generally different from the visual gradation, and even if accuracy is ensured in a narrow range of tones, it is hardly possible to make certain of its being secured in wider ranges. Another difficulty is that pigments have to be employed, and such pigments can never, of course, give pure colours. The consequence of this is that in the production of the picture it is necessary to vary the intensity of the different colouring agents employed until a satisfactory result is obtained. There is thus considerable room for judgment and dexterity, and the final result is not automatic, but depends on the artistic skill of the person who produces the picture. The whole process is, it must be admitted, of the character of a makeshift, but at the same time, when carefully employed it is a makeshift of considerable practical use.

Mr. Dresser, in the article printed below, deals only with the representation of natural objects for purposes of book illustration. An equally valuable application of the process is for the production of lantern slides for purposes of demonstration, and, as many of our readers are well aware, the process is beginning to be largely used for such purposes. A lantern slide coloured by hand is at best but a poor thing, and though a few very skilful operators—such as Mr. Cyril Davenport, of the British Museum—have by a combination of microscopic sight and great deftness of manipulation succeeded in producing some remarkable results, even these will hardly stand the large amount of magnification required by the lantern. Now a slide made by the three-colour process will stand as much enlarging as any ordinary photographic slide, and will give a reasonably close approximation to the natural colours of the subject. The process is applicable to any specimen which can be photographed. Excellent reproductions of microscopic objects have thus been produced; botanical specimens, birds, beetles and butterflies have all been rendered with great beauty and with really close accuracy to nature. Those who were present at Prof. Poulton's lectures at the Royal Institution last session had the opportunity of admiring the exquisitely coloured pictures he showed of insects, all produced by the process, which, first practically demonstrated by Mr. F. E. Ives, has since been further developed by Mr. Sanger Shepherd and others in this country.

Although, as said above, absolute accuracy is very difficult, or even impossible, to ensure—certainly not by automatic means—it is not too much to say that any photographer ought, after a very little practice, to be able to produce useful and serviceable illustrations for lecture purposes if he is content with something which, though not perhaps the best possible, is infinitely superior to anything which can be produced by painting an ordinary monochrome lantern slide.

Mr. Dresser in his remarks places, perhaps, needless stress on the difficulties of the process, and we are not quite disposed to agree with him as to its unsuitability for many purposes which he mentions. Although the exposures he gives may have been necessary by reason of the conditions under which his pictures were produced—namely, the photographing of the objects life size through a ruled screen and by the use of daylight at a time of the year when the light is not very good—it is a very different matter when it is required to produce illustrations for the lantern. In an ordinary studio, the exposure may take from, say, three minutes to a quarter of an hour through the red screen, which of course takes the longest time, while for out-of-door views in bright sunshine, with a moderate aperture of the lens, it is a matter of seconds only.

As a supplement to Mr. Dresser's account of the work he has carried on, we have added a summary of the account of the process given by Sir Henry Trueman Wood at the Royal Society's conversazione last May, when the rationale of the process was demonstrated.

THE THREE-COLOUR PHOTOGRAPHIC PROCESS.

To produce a photograph in colour direct from nature has for many years past been the dream and cherished aim of many photographers, but, so far as I can ascertain, these efforts have not met with success. By a happy combination, however, of the camera and the printing press, the so-called three-colour process has been so far perfected as to have become a commercial success, and, though still, perhaps, in its infancy, bids fair to become a serious rival to chromolithography, not only on account of its accuracy, but also because of its cheapness. Moreover, in the case of a larger number of copies being required, the total cost is considerably below that of chromolithography.

Upwards of twenty years ago, when the publication of my "Birds of Europe" was drawing to a close, I commenced to collect materials for a companion work on the eggs of European birds. When, however, it arrived at a question of illustrations, I found that I could not get plates sufficiently well and cheaply executed by any then known process. Besides which I could find no artist who could reproduce eggs in water-colour satisfactorily, and indeed, at the present time, I know of only one, a Danish artist, who can paint eggs with sufficient accuracy, and he is at present engaged on the illustrations for the British Museum "Catalogue of Eggs." Nor can he copy all sorts of eggs correctly, for in some species the markings are so minute and varied that no artist could exactly reproduce them.

In 1900, however, I saw a plate of fruit, photographed directly from the object, without the intervention of an artist, and reproduced by the three-colour process, which gave me the idea that it would be specially suited for the reproduction of natural history objects, and I at once commenced a series of experiments to test it with the assistance of Mr. I. D. Geddes, manager to Messrs. André and Sleigh, Ltd., of Bushey, Herts, and to his active cooperation I am indebted for the success that has crowned my endeavours. To produce the coloured picture three negatives are made from the objects on specially sensitised plates, which are exposed through "light filters" placed behind the lens. These filters separate out the colours of the objects into what are known as the primary colours—approximately red, blue and green. The negatives so obtained are then employed in the usual manner for the production of half-tone blocks—that is to say, each of the three pictures representing the separated red, blue and green images are etched as type blocks on copper for printing in the ordinary press, and it must be noted that the pictures as engraved on the copper blocks are made up of very fine dots. The plates are printed in the colour complementary to that of the filter through which each was taken, *i.e.* the red-filter picture in blue, the green in red and the blue in yellow. The printing of the plates is effected on three presses, one for each colour; the yellow image is first printed, then the red over the yellow printing, and, lastly, the blue over the red and yellow, and in each case the colour is allowed to dry before the next colour is printed. The registration of one colour over the other must be accurate, otherwise a blurring of the whole picture occurs. The colours used for printing are mixed each to a standard tint, which is only departed from in very exceptional cases.

The length of exposure for the process varies very much according to the conditions. As carried out for me by Messrs. André and Sleigh, in which the pictures were taken with a light-filter, a prism and a ruled screen interposed, the exposures were very long, the blue, approximately, ten to fifteen minutes, the green thirty to forty minutes, and the red nearly two hours. This process is eminently adapted for the copying of paintings, but the sole aim of the experiments made has been with a view to reproduce natural history objects, and more especially eggs, without the intervention of an artist.

Mammals cannot be photographed from living examples, as the exposure required is too long, and can only be done from paintings, for the reproductions are so very accurate that if photographed from stuffed specimens it is painfully apparent that they were stuffed. The same may be said with regard to birds, but when photographed from well-stuffed skins every character is most accurately reproduced, and such plates are consequently of extreme scientific value. Some fishes and crustaceans retain their colours for some time after death, whereas others fade almost immediately; the former of these can in most cases be reproduced from the specimens direct, but as regards the latter it will be necessary to employ an artist.

Shells of all kinds are specially adapted for this process, as colour-photography brings out even the bright iridescent colourings so characteristic of some species.

Flowers and plants, however, present serious difficulties, owing also to the long exposure required. Cut flowers will move and fade, and growing plants are sure also to move within three hours and thus spoil the pictures. Butterflies, moths and other insects can be photographed from the specimens direct if these are perfect, but they are often slightly damaged in catching, or in drying they become somewhat distorted, and any slight imperfection cannot be hidden, but is most faithfully reproduced; hence it is generally advisable to photograph from water-colour drawings of these objects.

Birds' eggs have chiefly occupied my attention, and with these I have been most successful, so much so that I purpose now to bring out my work on eggs, illustrated by this process from the eggs direct, without the intervention of an artist. At first I found a difficulty with the shadows, and tried the effect of a dark background; but as this took from the characteristic colours of some species, I had to revert to a pale background, and by degrees have overcome the difficulties, as will be seen from the plate accompanying the present article. The eggs figured on this plate are as follows:—

Figs. 1, 2, 3, eggs of the Lesser Kestrel, *Falco cenchris*; Figs. 4, 5, eggs of the Honey Buzzard, *Pernis apivorus*; Fig. 6, egg of the Levant Sparrowhawk, *Astur brevipes*; Fig. 7, egg of the Shikra Sparrowhawk, *Astur badius*; Figs. 8, 9, 10, eggs of the Blackwinged Kite, *Elanus coeruleus*. All these specimens have been selected to show the greatest variation in these eggs, and also to test the process.

H. E. DRESSER.

PRINCIPLES OF THREE-COLOUR PHOTOGRAPHY.[1]

The reproduction of the camera picture in its natural colours is still an unsolved problem, for Lippmann's results can hardly be said to have passed the experimental stage. They still lack practical application. All that can be done by photographic means is to select and combine colours, so as to produce an approximately correct reproduction of the colours of any natural object. The colour itself must be provided by the use of dyes, stains or pigments.

The principal application of the three-colour process

[1] Subject-matter of a demonstration given at the conversazione of the Royal Society on May 14 by Sir H. Trueman Wood.

is for the production of printed illustrations, but for purposes of demonstration its application to the production of pictures for exhibition by the lantern is much more convenient. By the use of a triple lantern the light from a single source can be divided up into three beams. If in the path of the beams we place screens of coloured glass of colours corresponding with the three primary colour sensations—red, green and blue—we have, of course, a disc of each colour projected on the lantern screen. If by moving the lantern lenses the three discs are caused to overlap, the colours will be mixed and combined. Where all three colours overlap there will be a white patch. Where only two overlap there will be a patch caused by the combination of those two colours, and this of necessity will be complementary to the third. We have therefore on the screen a coloured pattern showing white, the three primaries and their three complementary colours.

If in front of each lens of the lantern we introduce a simple pattern cut out of black paper, we shall, when the three images are separated on the lantern sheet, get three coloured reproductions of the three patterns. If they are of a suitable shape and suitably arranged we can combine these into a variegated pattern on the screen. We may take, for instance, such a simple pattern as a half-circle; then if we arrange the three half-circles in such a way that they do not coincide when projected together on the lantern sheet, but combine and overlap so as to form one complete circle, this circle will be divided into six sectors, three of which will show the primary colours and the other three their complementaries.

This simple experiment shows that it is possible to get a coloured picture by means of a black and white pattern and the three coloured glasses. In it, however, only the complementary colours are shown, because equal amounts of the primaries are combined. To get other tints, varying amounts of one or more of the component colours have to be used. Experimentally this is easily done by introducing in front of one of the lenses of the lantern an optical wedge—a sheet of glass coated with a neutral-tinted film, graduated from transparency at one end to opacity at the other. By cutting out, say, more or less of the red, we get a series of browns, greyish blues, &c.; by diminishing the green we get salmon colour, yellow ochre, &c. By this means it is evident that any desired tint which the human eye can appreciate can readily be produced.

Now a picture is only a complicated coloured pattern, and if we can analyse a picture and resolve its colours into the three components, arranged in their proper shapes, the combination of these three components will reproduce the picture as regards both shape and colour. Such analysis is possible by photography. A photograph taken through a red screen gives us the red component, and by using blue and green screens the blue and green components can be obtained. It is to be remembered that these photographs are merely monochrome photographs. They are simply ordinary photographs taken by a portion of the light of the spectrum, instead of by the whole of it. Making positive prints from negatives thus produced and projecting them on the screen, they show like ordinary lantern slides, except that each picture looks rather incomplete. In the red-light picture blue objects are but faintly reproduced. In the blue-light picture the red objects appear but feebly. When the coloured glass screens are interposed in front of the monochrome positives we get three pictures coloured red, green and blue respectively, and a combination of these on the sheet shows the original object in all its varied colours.[1]

[1] The ingenious photochromoscope of Mr. Ives works on precisely similar principles, except that the three coloured pictures are combined in the eye of the observer, instead of on the lantern screen.

The use of the triple lantern, however, is not very convenient, and there are certain drawbacks to its employment, though it suggests a possible means for the production of kinematograph pictures in colour. This is not yet possible, but it is conceivable that photographic films might be made capable of taking instantaneous pictures through the coloured screens, and that mechanism of sufficient accuracy could be constructed to register a series of three such pictures on a screen, so that they might be shown in the way animated photographs are now shown.

For practical purposes it is more convenient if we can have our coloured pictures in the form of an ordinary slide, which can be shown in the ordinary single lantern. Now it is quite obvious that with a single lantern we cannot use three coloured screens, one in front of the other. In the triple lantern we are mixing coloured lights, adding colour to colour. The superposition of one screen upon another in a single lantern merely means that only those rays will pass which can get through both screens, and the three screens together in the lantern would, of course, obstruct all the light, and the result would be nothing but darkness. With the triple lantern we are using a method of addition; with a single lantern we must use a method of subtraction or absorption.

The end can, however, be attained by the use of a film of bichromated gelatin, coated on a celluloid support. The film is printed and washed in the usual manner of carbon printing. The resulting relief in colourless gelatin is then stained the complementary colour to that by which the negative was taken. The need for employing the complementary colour is not difficult to understand. The bright parts of the red-screen positive represent bright red light. The dark parts represent the absence of red light, red shadows. When the film is stained, the transparent parts take little or no stain, the denser and thicker parts take the stain in proportion to their thickness. They should therefore be stained the opposite to red, the complementary to red (it is convenient to think of it as "minus red"), or blue-green. So the green-screen print must be stained "minus green," or pink, and the blue-screen print must be stained "minus blue," or yellow.

If we now take the three films and put the blue film in the lantern, we get a blue picture on the sheet. Putting in front of this the yellow film, our picture becomes partly blue, partly yellow and partly green, and we have some accession of detail. Adding again to this the pink film, we get at once all the different colours of the original object, and the picture is recognised as a practically correct reproduction of the original.

If the three films, instead of being mounted in such a way that they can be shown in the lantern, are stripped from their supports and superposed one above the other on a sheet of white paper, we get a coloured picture suitable for use as a book illustration. This process is quite practical, but it is by no means easy, and, of course, it is useless for the production of large numbers. For commercial purposes no process can be of much service which is not applicable to the printing-press. Now it must be familiar to most people that a printing-block can be produced from any photographic negative. The methods by which this is effected are well known, and they are in constant use, the great bulk of the black and white illustrations in magazines and newspapers being now produced by them. It is, therefore, not difficult to see that if from each of our negatives we make a printing-block and use the three blocks to print—the blue-screen block in yellow ink, the green-screen block in red ink and the red-screen block in blue ink—we are merely varying the process by substituting films of printing-ink for films of stained gelatin. This is, indeed, in barest outline the method by which the very numerous coloured illustrations made by the three-colour process are all produced.

FIRE-WALKING IN FIJI.[1]

IN connection with the Coronation festivities at Suva, there was to have been a fire-walking ceremony, but, owing to the illness of the King, the Government of Fiji decided that nothing could take place; however, a large party of excursionists from New Zealand managed unofficially to obtain an exhibition of the fire-walking. The following notes have been abstracted mainly from an account by Mr. Walter Burke, in the Christchurch *Weekly Press* (July 16, 1902) and from a condensed report in the *Evening Star* of a paper read before the Otago Institute by Dr. Robert Fulton, which some time next year will be published in the *Transactions*.

FIG. 1. The Natives walking on the heated stones. (From the Auckland *Weekly News*.)

The ceremony was performed on the island of M'Benga, near Suva, by members of the Nga Ngalita tribe, all of whom are credited with being specially gifted in the way of heat-resistance. In the centre of a space cleared in a coconut grove was a circular pit, about 20 feet in diameter and 2 feet in depth, the earth from the centre being piled round the periphery. Poles were placed radiating from the centre, dry palm fronds were placed on these and firewood stacked above. Finally, large stones were heaped on the top until the whole pile was several feet in height. The fire was lit about forty-eight hours before the ceremony took place, and it was kept fed with fresh supplies of wood. Eventually the whole mass glowed with a white heat; it was not comfortable to stand within a few feet of it, and also it was dangerous, as large splinters of stone flew far and wide.

As the hour for the exhibition approached, the natives brought green saplings about 20 feet in length, armfuls of green branches, and masses of green vines of great length and considerable thickness. The following is from Mr. Burke's account:—

"The fire is now sinking, and occasionally a large stone drops through. There is little smoke and the stones fairly glow. Now the workers close in. The smaller vines are fastened in loops at the ends of the long saplings. A loop is dropped over the end of a log not yet burnt out, and with loud chants the log is drawn out. This is repeated till no logs are left. The ends of the saplings continually burst into flames as they touch the stones. At last there seems to be nothing left in the pit but stones, some of which are shivered to pieces by the great heat. The large hawser-like vine now comes into use. This is thrown across the pit to one side, and with the saplings the men force it down into the glowing stones. Now dozens of willing hands pull at the ends, and the stones are turned over and over and flattened out. Many stones that were at the bottom are now on top, and *vice versâ*. This is done until the stones present a fairly even surface, but critical men, still unsatisfied, probe amongst the stones with the saplings and turn the smoothed side uppermost. While they are doing this, the green saplings blaze vigorously.

FIG. 2.—On the burning leaves. Immediately after the fire-walking, green leaves were thrown on the hot stones. The fire-walkers then leaped back on to the leaves, which burned and gave off great masses of smoke. In this illustration, the men can be seen dimly through the smoke. (From the Christchurch *Weekly Press*.)

"Now all is ready for the grand finale. The workers step back. One of the men who is to walk comes out for the examination by Drs. Smith and Fulton, of

[1] The interesting illustrations which accompany this article have been reproduced from the Auckland *Weekly News* and the Christchurch *Weekly Press*, in which several other pictures of a similar remarkable character are given. As several months would elapse before permission to use these illustrations could be obtained from New Zealand, we have taken the liberty to reproduce two from the periodicals mentioned. It would be a pity to delay bringing pictures of such scientific interest before readers of NATURE.—[ED.]

Dunedin, who are unable to discover anything out of the ordinary. The chief asks for silence and a hush falls on the scene. The assembled natives break into loud cries, and along a track in the jungle-like growth can be seen a party of ten Fijians fantastically dressed.

"Without hesitation or haste, they step on to the stones and walk round the pit, taking some ten to fifteen seconds to complete the circuit. They step off quickly, and in a moment great masses of green leaves are thrown on to the centre. The fire-walkers rush back and press down the leaves with their feet and hands. The steam rising from the leaves envelops them in a cloud. Baskets of native food are passed in, and more green leaves are heaped over until a mound is made."

Dr. Fulton states that the man Dr. Smith and he examined before the fire-walking was of fine physique, with a pulse a little over 90 and the hands and feet cooler than the rest of the body. The feet were perfectly clean and odourless, and no preparation could be detected on them. The soles were yellowish-white, perfectly smooth and pliable, and like soft kid. The man wore a *sulu* (petticoat) of dry hibiscus bark and canna leaves, with small anklets of dry bracken. Each man as he walked kept his eyes on the stones. One man was examined afterwards; his pulse was about 120; the soles of the feet seemed cool, if not cold, but on running the hand up the leg, a most pronounced difference in temperature was observable; on the calf, it was like that of a man in a high fever. None of his vegetable clothing was scorched, not even the dry bracken anklets, and the short, black, crisp hairs on the legs were not singed. Dr. Fulton went to the edge of the pit immediately after the ceremony and stirred up some of the stones with his foot. He stood for a second on one or two and found that they did not brown his boots, though evidently they were too hot to handle. He asked a native to get him one of the stones, and the man coolly walked up and began to move about the heated stones with his bare feet. This was not one of the "fire-walking" men, but one of those who had come from Suva. He raked out a piece of stone from the heap, but it was too hot to hold in the hand.

The explanation Dr. Fulton offers is as follows. The arrangements for heating were peculiar; if what was required was merely a surface of red-hot stones to walk upon, it would be easier to lay flat stones in the pit and to maintain a huge fire on them. The stones took forty-eight hours to get to their "proper" condition, and the subsequent cooking of the food took two days instead of an hour or so. The stones also were found to cool very slowly. The same stones are never used twice. They are gradually heated until split by the expansion of the contained water, and are then carefully arranged fractured side upwards. The stone that was examined was an augite-andesite of ordinary type. Prof. Park, of the Otago School of Mines, found that, taking the thermal conductivity of copper as equal to 1000, that of andesite is 6·67, that is, it is a very feeble conductor of heat. In testing the radiation, iron being the standard at 100, andesite is 48. Thus the fractured, or inside, surface of the stone, owing to its slow conductivity, does not receive nearly the amount of heat one would expect, and, owing to the slow radiation of heat, the foot is not burnt when coming into contact with the stone for a second or less; as a matter of fact, the sole of the foot was at no time in contact with a hot stone for more than half a second. The foot is naturally cold or artificially cooled; it is a well-known fact that one can bear with cold feet for a long time (up to a minute in some instances) heat from a fire which would be insupportable for five seconds at ordinary foot temperature.

A good deal has been written at various times on walking on heated stones or glowing embers. It will be in the knowledge of our readers that there was published in NATURE of August 22, 1901, an article on Tahitian fire-walking, by Prof. S. P. Langley, in which a somewhat similar explanation was given. It is satisfactory to find that these investigations by scientific men agree, on the whole, with one another in principle, and that a rational explanation is forthcoming for a sensational performance which unskilled white observers usually regard as mysterious or even as miraculous. The walking on glowing embers, which is well known in parts of India, as recently described in the *Bulletin* of the Madras Government Museum (vol. iv. 1901, p. 55), probably has another solution. The fire-walking ceremonies in India, Japan and elsewhere require to be carefully studied by trained observers. A. C. H.

THE PRESENT STATE OF WIRELESS TELEGRAPHY.

IT is now eighteen months since we last attempted in these columns to take a general survey of the development of wireless telegraphy. In the history of a science which has enlisted the services of so many skilled experimentalists, each of whom has made rapid progress along his own lines, eighteen months is a comparatively long period; as a result, we are compelled to-day to regard the subject from a very different point of view. At that time, there were practically only two systems—Mr. Marconi's and Prof. Slaby's—which had advanced to such a degree of perfection that they deserved special consideration. To-day, it would hardly be too much to say that in every civilised nation there are one or more inventors with a carefully worked-out and tested system ready for general use. Particulars of these different systems have been published from time to time and have been duly referred to in NATURE; unfortunately, the information published is not, as a rule, of the kind that one most desires to obtain; too often it is obviously "inspired," and consists for the most part of insufficiently supported claims to successful syntonisation, or to record making in the way of long-distance transmission or rapid signalling, information which is very acceptable to the daily papers, which forget one day what they have published the day before, but of little use to those who are seriously interested in the subject.

So far as can be judged, the various systems differ chiefly in matters of detail, the design of circuits and the special construction and arrangement of apparatus; improvements depending on the introduction of a principle fundamentally new are few and far between. We do not wish to underrate the value of these detailed improvements; they are, as we well know, often the talismans converting failure into success, but their interest is mainly for the specialist It is not our intention, therefore, to enter into a detailed examination of the different systems; to do so would only involve us in a mass of technicalities from which the reader would probably "come out by that same door where in he went." Those who wish for this information must be referred to the technical Press or to the files in the Patent Office, where they will probably find, as, for example, in the two hundred odd claims in Mr. Fessenden's patents, all the particulars they desire. We propose rather to treat the subject on a broader basis, and to endeavour to form an estimate of how far wireless telegraphy in its present state has fulfilled the expectations that have been raised in the past or justifies hopes that may now be entertained for a future of wide utility.

The first question that one feels inclined to ask is, At what end are all these inventors aiming? Is it to devise a system of wireless telegraphy to compete with the ordinary telegraphic methods, or is it for what seems to us the more useful purpose of creating a means of communication where none now exists, especially between ship and ship and ship and shore? It would seem that in some instances, as,

for example, that of the Marconi Company, the former purpose is almost as much in view as the latter. In the former case, there can be no question but that absolute syntonisation is necessary; in the latter, it is less important and even in some respects undesirable, but, on the other hand, it is essential that the different systems should work together so that any ship should be able to signal to any station. It would be a great misfortune if this principle is lost sight of in the rivalry between competing methods and if we thereby lose what seems to be in reality the greatest benefit wireless telegraphy can confer, the increase of the safety and convenience of travelling by sea. This is, we think, the most urgent problem that wireless telegraphy presents to-day, and we trust that it will find a really satisfactory solution at the coming Berlin Conference.

The attempts which have been made at syntonisation are, indeed, far from encouraging. It is true that almost every inventor claims that he has solved the problem, but all the experiments that have been quoted are open to criticism. It is important to recognise what a successful solution really means; it is not sufficient to demonstrate, as has been done many times, that two messages can be transmitted or received at the same time by the same installation without interference: that, in short, duplexing is possible: this is a great step, no doubt, but to solve the problem it is necessary that the tuned transmitter shall affect no other receivers than those syntonised with it, and that the tuned receiver shall respond only to the proper waves; this, it will be seen, is a requirement much harder to satisfy. As an example, showing how far existing practice is from satisfying these conditions, we may quote the case of the recent long-distance work done by the Marconi Company. Mr. Marconi, it will be remembered, has several times claimed to have solved the problem of syntonisation, and, confident of having done so, issued a challenge last February to Sir W. Preece or Sir O. Lodge to intercept any of his messages, offering to put a station, in the neighbourhood of his Poldhu station, at their service. This challenge has been answered in a conclusive manner during the past month by Mr. Nevil Maskelyne, who showed that the installation which he was working at Portcurnow had been receiving the messages sent to the *Carlo Alberto* on her recent cruise from England to Italy (see the *Electrician*, vol. l., pp. 22 and 105). It is clear, therefore, that, with no special preparation on either side, it is possible to tap the signals that are being sent by the Marconi Company over long distances, and in face of this the claims to a real solution of the syntonisation problem fall to the ground. We doubt whether any other system would stand the same test.

But if on this side the outlook is somewhat dispiriting, in other directions matters are more encouraging. This year has witnessed the remarkable achievements by the Marconi Company in long-distance work. It has been shown that it is possible to signal across the Atlantic, a distance of more than 2000 miles over water; and in the cruise of the *Carlo Alberto* signals were transmitted a distance of 750 miles over land and water. To cover these great distances, the power used at the transmitting station has to be correspondingly great; in consequence, the signalling was only from Poldhu to the ship and not in the reverse direction. The importance of these experiments, however, lies rather in the conclusive demonstration of the fact that it is only a question of providing sufficient power to signal over any distance, however great, and therefore no fears need be entertained of the utility of the wireless telegraph being limited by considerations of distance. No other experimenter has attained such success in long-distance work as Mr. Marconi, but no other experimenter has used such large power for transmission. Unfortunately, sufficient particulars are not available to enable a comparison to be made between the distances attained with different systems using the same amount of power; this is a point on which the publication of trustworthy data would be of the highest value. An interesting phenomenon brought out by Mr. Marconi's long-distance work is the effect produced by daylight on transmission. It is found that the signals carry much further during the night (*i.e.* night at the transmitting station), the result being due, it is suggested to the discharging effect of sunlight on the aërial wire (see NATURE, vol. lxvi. p. 385).

With reference to long-distance work, the interesting experiments of M. Guarini with an automatic repeater may be quoted. This inventor designed an apparatus which should pick up a message received from one station, A, and pass it on to a second station, B, which was out of the range of the signals transmitted direct from A. The principle of this apparatus will be understood from the accompanying diagram (Fig. 1), in which, for the sake of clearness, only the essential circuits are shown. The aërial wire A at the repeating station is connected through the contact 1 of the relay R_1 and through the primary of a transformer T to earth; it is also connected through the spark gap S to earth. The coherer is connected in series with the secondary of T and a condenser. When a signal is received, the resistance of the coherer is broken down, and the battery B_1 sends a current through it and the relay R_2, thus closing at the contact 3 the

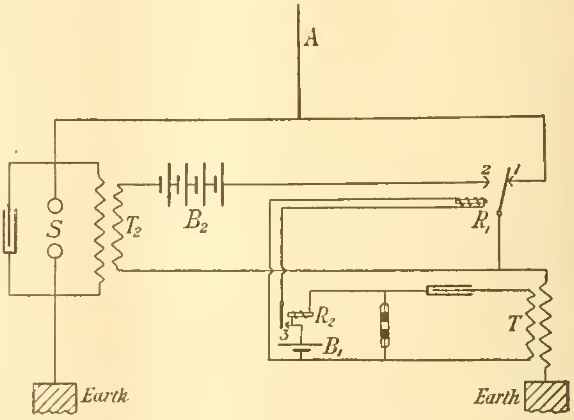

FIG. 1.—Diagram of Circuits in Guarini's Repeater.

circuit of the relay R_1. The contact arm of R_1 swings over to 2, thus disconnecting the aërial from the receiving circuit and closing the primary of the induction coil T_2, thereby causing a spark to pass across the gap, which means that the signal is sent out again from the aërial A. The coherer being tapped back, the various circuits are opened, and the arm of R_1 returns to its original position and so is ready to receive the next signal. Experiments were carried out between Antwerp and Brussels (42 km.), the repeating station being at Malines, about half-way between the two; the results were promising, though the repeater did not prove absolutely trustworthy.

We may now turn from the consideration of the results achieved to the apparatus that has been used. In the transmitting apparatus, attention has been chiefly devoted to devising means of generating oscillations of definite wave-length. None of these call for special comment. In some cases, for obtaining the spark, alternating-current generators have been employed in connection with step-up transformers instead of induction coils. This is the case in the de Forest system, which, it may be remarked, claims the record for speed of forty-eight words per minute; the alternator generates, at 500 volts, 60 cycles, and this is stepped up to 25,000 volts for sparking; the signals are formed by interrupting the primary circuit of the transformer by means of a specially designed key. The difficulty of breaking a large current in this way is consider-

able, and has obviously proved a stumbling-block to the Marconi Company, as it forms the subject-matter of two or three patents taken out by Prof. Fleming and the Company. Some of the methods described therein are exceedingly ingenious, but, unfortunately, space does not allow us to describe them here, especially as their bearing on wireless telegraphy is only indirect.

With the exception of the magnetic detector devised by Mr. Marconi and tested during the cruise of the *Carlo Alberto*, practically all the different systems make use of the coherer principle for receiving. The actual type of coherer used differs considerably in the several cases. For long-distance work, it has generally been found most suitable to use a coherer which requires no tapping back, but spontaneously returns to its normal condition, this being connected in parallel with a telephone. One of the chief advantages of this arrangement lies in the fact that the energy required to give audible signals in the telephone is much less than that needed to work a relay. There are several different coherers working on this principle—the principle really of the microphone; in the system devised by M. Popoff, carbon granules form the loose contacts, the resistance, which is normally high, being broken down by the received waves and the coherer then restoring itself to its original condition; the change

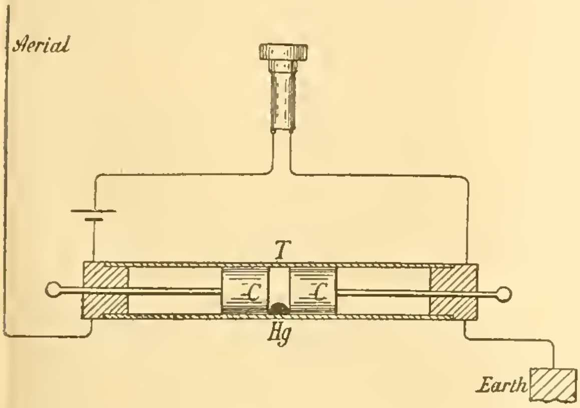

Fig. 2.—Castelli Coherer and Connections.

in the current through the coherer causes a click in the telephone. In the de Forest system, an electrolytic "anticoherer" is used; this has a paste, composed of a viscous material, loose conducting particles and an electrolyte, between suitable electrodes. In the normal condition, the conducting particles bridge the gap and give the receiver a low resistance; electrolysis is set up by the received oscillations and the consequent polarisation greatly increases the resistance. Of the coherers of this type, the greatest interest attaches to the Castelli coherer. This, invented by a semaphorist in the Italian navy, was used by Mr. Marconi in his first Transatlantic experiments. Its construction is shown in Fig. 2. Two iron or carbon electrodes, C C, fit into the tube T and are connected by a single drop of mercury Hg. The connections shown are, of course, the same in the case of the two other coherers just described. When electrical oscillations reach the tube, the mercury coheres to the electrodes, but returns at once to its normal condition when the stimulus ceases. The magnetic detector to which we have made reference above was described by Mr. Marconi in a paper read before the Royal Society last June. Fig. 3 shows the principle of its construction. It consists of a core of thin iron wires, I, over which are wound two coils of fine copper wire, C_1 and C_2. The outer core, C_1, is connected to a telephone receiver and the inner, C_2 to the aërial and earth or to the secondary of a transformer the primary of which is connected to the aërial and earth. The iron core is magnetised by a permanent magnet, M, at one end, which is rotated by clockwork so as to produce a continual slow change in the magnetisation, which, however, owing to the hysteresis, lags behind the magnetising force. When oscillatory currents pass through the inner coil, there is a sudden decrease in the hysteresis, due apparently to the molecules being released from restraint: a corresponding sudden variation in the magnetisation of the iron results, and this induces a current in the outer winding connected to the telephone.

Such, in brief, are the more important advances that have been made in the practice of wireless telegraphy during the past year. In addition, much work has been done on the purely scientific side of the subject, the action of the coherer in particular having been submitted to somewhat rigorous examination, work which has already produced results which may prove both of great physical and great practical value. It may fairly be said that we know now, with a considerable degree of certainty, some of the more useful services which wireless telegraphy may be relied upon to perform. Already its commercial application is considerable; many ships, in the navies of this and other countries and in the merchant services, are equipped with wireless telegraphic apparatus which has, we believe, fully justified its instal-

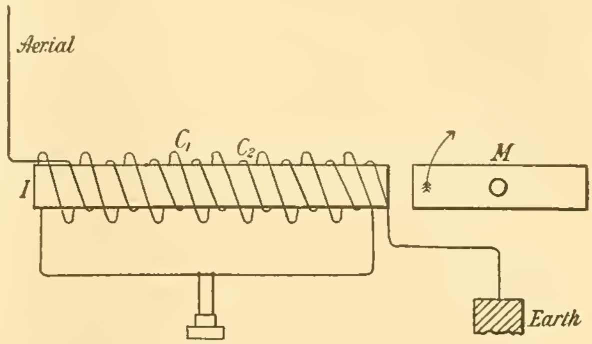

Fig. 3.—Diagram of Marconi's Detector.

lation. It is in this direction that we look with the most confidence for a steady increase in its application, and we would rather hear of a few more ships being thus equipped than of another "S" being transmitted across the Atlantic.

Maurice Solomon.

NOTES.

The Paris correspondent of the *Times* announces the death of M. Dehérain, professor of vegetable physiology in the Museum of Natural History, and of M. Hautefeuille, mineralogist at the Faculty of Sciences. Both were members of the Paris Academy of Sciences. The death is also announced of M. Alexandre Bertrand, one of the original founders of the fine museum of St. Germain, of which he had been curator since 1862. He was also professor at the École de Louvre of national archæology, and his fame as an archæologist was world-wide.

The great dam on the Nile at Assuan is to be inaugurated by the Duke and Duchess of Connaught as we go to press with this number. Sir Benjamin Baker, K.C.M.G., has been appointed to be a Knight Commander of the Order of the Bath, in recognition of his services in connection with the construction of the Nile reservoir. Other honours conferred in connection with the work are:—To be G.C.M.G., Sir William Edmund Garstin, K.C.M.G., Under-Secretary of State for Public Works in Egypt. To be K.C.M.G., Major R. H. Brown, R.E., C.M.G.,

and Mr. W. Willcocks, C.M.G., of the Egyptian Irrigation Department. To be C.M.G., Mr. A. L. Webb, Mr. K. E. Verschoyle, Mr. M. Fitzmaurice and Mr. G. H. Stephens.

THE suggestion that the British Association should meet in South Africa in 1905 was mentioned in these columns some time ago. The following statement with reference to the meeting has now been published in the daily papers:—Reuter's Agency is informed that the suggestion that the British Association should hold its annual meeting for 1895 in South Africa emanated from the new South African Association of Science, of which Sir D. Gill, Astronomer Royal for the Cape, is president. Before the last meeting of the British Association at Belfast, invitations were sent from the municipalities of Cape Town, Kimberley, Bulawayo and other centres in South Africa, and it is understood that these have been accepted, and that the session of 1905 will be held in South Africa. Scientific papers will be read at various centres in the South African Colonies, and visits will be paid to various places of interest. A sum of 7000*l.* has been collected in South Africa for the entertainment of the Association. While in Rhodesia, the men of science will be the guests of the Chartered Company, who will place the railways at their disposal and, among other things, take them by special train to the Zambesi, where they will stay at the new hotel to be erected near Victoria Falls. Probably the guests will leave England in a special steamer.

AT the meeting of the Royal Geographical Society on Monday, Dr. Sven Hedin described to a large audience the results of his explorations in Central Asia during the three years 1899–1902. Before the reading of the paper, it was announced that Dr. Sven Hedin had been awarded the Victorian medal of the Society for geographical survey. The scientific records and other material obtained during the expedition are of great value, and include some interesting evidence of secular movements in the region of Lop-nor. The surface of the lake of Kara-koshun was found to be about seven-and-a-half feet below the northern shore of the ancient lake of Lop-nor. The lake of Kara-koshun is gradually disappearing in the place where Prjevalsky found it, and slowly creeping northwards towards its ancient bed, where Dr. Hedin believes it will be found at no great distance of time. The lake is getting choked with mud and drift-sand and decaying vegetable matter; while, on the other hand, the northern part of the desiccated desert is being eroded and furrowed by the winds, and is thus growing deeper and deeper every year. As the lake moves, so do the vegetation and the various animals of the desert. They, as well as the fisher-folk, with their reed huts, follow after to the new shores, while the old lake gradually dries up. There are reasons for believing that in the far-off future the same phenomena will recur again, but in the reverse order, though the natural laws which will effect the reversal will remain precisely the same. Whenever that occurs it will be possible to determine the length of time required for these periodic changes. Dr. Hedin pointed out, however, that it is already known that in the year 265 A.D. the lake of Lop-nor lay in the northern part of the desert. Lop-nor is, as it were, the oscillating pendulum of the Tarim River, and each oscillation probably extends over a space of a thousand years or more.

THE following men of science have been elected honorary members of the Cambridge Philosophical Society:—Profs. Bayley Balfour, A. H. Becquerel, E. Fischer, Richard Heymons, J. H. van 't Hoff, M. Jordan, H. F. Osborn, W. K. von Röntgen, Corrado Segre and Hugo de Vries.

THE Antarctic relief ship *Morning*, carrying provisions for the *Discovery*, now in Antarctic regions, sailed from Wellington, New Zealand, on December 6.

THE *Times* correspondent at St. Thomas, in a message dated December 6, reports that Mont Pelée has been dangerously active during the past week. There has been a heavy fall of ashes, and vessels were advised not to approach the coast.

AN ascent of the Soufrière while still in a state of activity was made, on October 28, by Mr. J. P. Quinton, of the Botanic Station of Sierra Leone. Mr. Quinton and his party were the first to try the ascent since the eruption of October 15–16. Some of the ridges they had to cross were not more than six inches wide, with a fall of a thousand feet on either hand. The ascent took two and a half hours stiff climbing. Mr. Quinton found that the new crater had unwarrantably been held responsible for the mischief of October 15; only the old crater was doing anything. This was discharging volumes of steam and water, and was throwing stones and ashes to a height of 30ft. or more. But no lava at all seems to have been ejected. The steam comes up through a fissure in the south wall of the crater, hangs along in a depression close in under the south-eastern wall, and, finally gaining the summit, is blown over to the west, making it look as though it were coming from the new pit. The old crater is very much wider than it used to be and more funnel-like. Red-hot stones and ashes are piled up on all sides—in some places over the rims. All through the night and the following morning while the party was on the mountain, rumbling sounds were constantly emitted, with clouds of steam and showers of ashes.

A *Times* correspondent describes the recent eruptions in Guatemala as communicated to him by a resident in the republic. On October 24, at about 5 p.m., a violent eruption took place in the ravine which divides the volcano of Santa Maria from that of the Siete Orejas. At 5 a.m. on October 25, subdued noises were heard, emanating apparently from the direction of Quezaltenango. Later on the detonations grew louder. At 6 p.m. the eruption reached its climax. For about an hour the detonations had ceased, when, by a terrific outburst, the whole of the capital was thrown into a panic and everybody rushed out into the streets. This cannonade lasted for ten minutes, during which time the strongest built houses shook violently. At intervals the detonations continued through the night and in a less degree afterwards. The explosions were heard in the south of Nicaragua, and a telegram was received from San Salvador stating that the inhabitants had rushed into the streets in terror on hearing the noise. Quezaltenango was thirty-six hours in total darkness, during which time a heavy rain of ashes and sand had been falling. The manager of the Sabinas Estate, which lies just above the scene of the eruption, says that at about 5 o'clock on October 24 they were alarmed by a series of earthquakes of a throbbing nature, which appeared to come from below them. Almost simultaneously, a cloud of steam was seen to issue from the ravine already mentioned, about a league away. Soon ashes and sand, accompanied by small stones, commenced falling, and two hours later the odour of sulphur and gases was so great that he could hold out no longer, and he left on foot for Retalhuleu, a distance of some thirty miles. Reports from the other planters confirm the fear that the whole of the Costa Cuca, probably the richest coffee zone in the country, is totally ruined.

AMONG the lectures to be delivered at the Royal Institution before Easter, we notice the following:—Prof. H. S. Hele-Shaw, six lectures (adapted to young people) on locomotion, on the earth; through the water; in the air (experimentally illustrated); Prof. Allan Macfadyen, six lectures on the physiology of digestion; Sir William Abney, three lectures on recent advances in photographic science; Sir Robert Ball, three lectures on great problems in astronomy; Mr. A. J. Evans, three lectures on pre-Phœnician writing in Crete and its bearings on

the history of the alphabet; Sir Clements Markham, three lectures on Arctic and Antarctic exploration; Mr. G. R. M. Murray, three lectures on the flora of the open ocean; and six lectures by Lord Rayleigh. The Friday evening meetings will begin on January 16, when a discourse will be delivered by Prof. Dewar on low temperature investigations; succeeding discourses will probably be given by Dr. Tempest Anderson, Prof. W. E. Dalby, Prof. S. Delépine, Principal E. H. Griffiths, Dr. A. Liebmann, Prof. J. G. McKendrick, Prof. Karl Pearson, Prof. E. A. Schäfer, Prof. W. A. Herdman and Lord Rayleigh.

AFTER the formal acceptance, by the British Government, of the invitation to take part in the Universal Exhibition which is to be opened at St. Louis on May 1, 1904, it was decided to prepare and distribute an illustrated descriptive pamphlet for the guidance of intending exhibitors and visitors from the United Kingdom. The booklet sets forth the plan of the Exposition, gives estimates of the men and the historic events to be commemorated, provides a comprehensive review of the various exhibits, and explains the relations which foreign countries, the Government of the United States and the States of the Union bear to it. About twenty-five foreign countries, including Great Britain, France, Germany and Italy, have decided to take part in the Exhibition. France has already made a preliminary appropriation of 650,000 francs, and it is believed this will be at least doubled next year. Germany's exhibit is expected to be even finer than that at the last Paris Exhibition. Japan has made an initial grant of 800,000 yen (about 80,000*l*.). The British Government is to be asked, a *Times* correspondent says, to enlarge the scope of its acceptance, which is limited thus far to the assurance that complete exhibits will be made in art and education, and facilities afforded to industries.

ON Monday, at the Society of Arts, Sir George Birdwood, K.C.I.E., was given evidence of the regard in which he is held by many leaders of thought, for he was presented with a testimonial in the form of some handsome silver plate and a purse of money. In making the presentation on behalf of the committee and subscribers, Sir Owen Tudor Burne alluded to the fact of Sir George Birdwood's having entered the East India Company's service forty-eight years ago. Being afterwards stationed at Bombay, he became one of its leading citizens, founding, among other beneficial works, the Victoria and Albert Museum and the Victoria Gardens, besides greatly enlarging the local branch of the Royal Asiatic Society and throwing open its membership to public-spirited and learned Hindus, Mohammedans and Parsees; he was mainly instrumental in raising the necessary funds for the building and endowment of the Bombay University, and was also the author of various writings on Indian art and botany and Indian local and Imperial questions.

THE bending of two alabaster slabs in the Alhambra palace at Grenada was mentioned by Mr. Spencer Pickering (p. 81) in connection with a letter by Dr. See (p. 56) on the bending of a marble slab under its own weight. Dr. Bleekrode, writing from The Hague with reference to the Alhambra slabs, remarks that they are nearly 3 metres long, and are 23 centimetres wide and 5 centimetres thick. The curvature begins at a distance of about 1 metre above the floor and the radius is nearly 9 metres. The pressure is estimated to be equal to about 1600 kilogrammes. Dr. Bleekrode points out that the Alhambra was built at the end of the thirteenth century and began to deteriorate nearly two hundred years ago. He suggests that possibly if the masonry causing the pressure were removed, the slabs would become flat again, in which case the bending would have to be regarded merely as an effect of elasticity.

DR. T. A. JAGGAR, JUNR., of Harvard University, in a letter to *Science*, directs attention to a peculiar sequence followed by the great eruptions of Mont Pelée this year. Since May 5, eruptions of the first magnitude have occurred at intervals of increasing length, as will be noticed from the following dates of violent disturbances of the volcano;—May 5–May 8, three days; May 8–May 20, twelve days; May 20–June 6, seventeen days; June 6–July 9, thirty-three days; July 9–August 30, fifty-two days. The progressive increase of the interval between the eruptions does not follow any simple arithmetical law, but from a graphic representation of the facts a curve is obtained which suggests that the interval after August 30 has a length of 112 days. If that is the case, a great eruption of Mont Pelée might be expected to occur about December 20.

DURING the past week, this country has experienced abnormally cold weather, and sharp frosts have occurred at night, while the day temperatures have on several occasions only risen slightly above the freezing point. North-easterly and easterly winds have for the most part prevailed, and at times they have blown with considerable strength; snow has fallen in many places, and in the south of England the ground remained covered for some days. The cold spell has been caused by the extension of the European area of high barometric pressure over our Islands, and this has brought this country under the influence of the severe weather which has prevailed on the continent. On the night of December 6–7, the thermometer at Greenwich fell to 24°·5 in the screen and to 18°·7 on the grass, but still lower temperatures have been recorded in parts of England and Scotland. The anticyclone over northern Europe has apparently become fairly well established, and with its continuance the weather is likely to remain cold.

WE have received from Dr. Hergesell, president of the International Aëronautical Committee, a preliminary report upon the scientific balloon ascents made on the first Thursday in each of the months July, August and September last. The ascents, which were made by manned and unmanned balloons and kites, were joined in by Austria, France, Germany, Hungary and Russia on the continent, by England (Mr. Alexander), Scotland (Mr. Dines), and Blue Hill Observatory, in the United States. Readings at altitudes near or exceeding 10,000 metres were obtained in the following cases:—Berlin (July), −52°·5 C. at 15,690m., ground temperature 9°·4. Strassburg (August), −41°·7 at 10,160 m., temperature at starting 18°·4, and about half an hour later (5h. a.m.), −53°·1 at 11,900m., ground 16°·2. Berlin, −68° at 18,500m., ground 13°·5. Bath, −47°·2 at 9305m., temperature at starting (8h. a.m.) 15°·6; the greatest height reached was 11,350m. Strassburg (September), −54°·7 at 12,200m., ground 17°·7. Pavlovsk, −49°·7 at 11,100m., temperature at starting 13°. The ascents were made under the following barometric conditions:—In July, high pressure existed over the western part of Europe; in August and September, areas of low barometric pressure were prevalent.

WE have received from Dr. Robert Bell, acting director of the Geological Survey of Canada, the western sheet of the geological map of the Dominion, on a scale of fifty miles to an inch. It is very clearly printed in colours, and will be of much service as an index map to the structure of the country.

IN an article on the composite gneisses in Boylagh, West Donegal (*Proceedings* Royal Irish Academy, vol. xxiv., 1902), Prof. G. A. J. Cole argues that we have the intermingling and incorporation of two dissimilar masses of stratified and igneous material, and that the gneisses have resulted from the complex metamorphism to which the masses have been subjected.

MR. R. T. HILL (*Journal* of the Franklin Institute, August-October) gives a graphic account of the Beaumont oil-field, a district within the area of the coast prairie of the Texas, Louisiana and Mexican region. The oil was discovered in 1901 by a drill-hole through 1100 feet of clay and quicksand. A year later there were 136 wells, now there are 214, and more are being drilled. During the first year, 5½ million gallons of oil were obtained, and five or six times this amount is estimated as the product for 1902. The prairie land extends for nearly 400 miles along the Gulf of Mexico and from ten to fifty miles inland. The strata at a depth probably comprise bituminous Eocene clays, and they are overlaid by later Tertiary and Pleistocene sands and clays, nearly 3000 feet in thickness, which contain the oil; and these, again, are covered by prairie deposits of sea-mud and sand. A drill-hole has been carried to a depth of 3050 feet without touching the Eocene. In some localities, hot water has been struck below the oil, and the oil itself is sometimes hot. Gas has been encountered in some of the bore-holes. It is remarked that the water becomes not only hotter but more saline with increasing depth, thereby raising its capacity for the collection and flotation of oil, which is preserved in the porous strata overlying the Eocene clays and is sealed up by the superincumbent muddy sediments.

PROF. O. COMES, of Portici, Naples, has prepared a series of chronological charts which furnish data concerning the introduction, cultivation and general spread of tobacco for all important countries throughout the world.

WITH the present contribution (No. 13), Sir George King has brought the "Material for a Flora of the Malayan Peninsula" to the end of the Calycifloræ. The genus Begonia furnishes 19 species, of which 14 are new to science; most of these were collected in Perak, several at altitudes varying from 3000 to 7000 feet. Two new species of Mastixia are also described. As in the case of the Thalamifloræ and Discifloræ, a complete list of Calycifloral species has been published separately.

THE possibilities of pitcher plants as a trap for catching the American cockroach, *Blatta americana*, are pointed out in the October *Bulletin* of the Trinidad Botanical Department. Planted amongst orchids, they may materially help the cultivator to keep this pest in check, and are more especially suitable since they require similar conditions of heat and moisture. A note on the "Nitrogen Content of Flowers" emphasises the manurial value of those of the Immortelle, and Nicaragua shade plants which are sown amongst cacao plants. A new fruit obtained from the Bocas Islands and provisionally determined by the Kew authorities as *Anamomis esculenta*, judging from its flavour and aroma, seems likely to furnish good table fruit.

THERE is a strong physiological tendency displayed in the *Bulletin* of the College of Agriculture connected with Tokyo University. Several papers by Mr. K. Aso deal with the action of certain poisonous substances when supplied as food to seedlings. Salts of manganese, even in weak solutions, have an injurious effect, but if the solution is diluted to contain about 0·002 per cent. of the salt, then the result is stimulating. Similar stimulating effects were obtained with very dilute solutions of other poisonous salts. The same author contributes a suggestive paper on the oxidising enzymes in plants. Mr. M. Toyonaga, on the animal side, obtains results which are in keeping with Prof. O. Loew's hypothesis that the amount of calcium varies with the size of the nucleus.

WE have received a copy of vol. v. No. 1 of the *Bulletin* of the College of Agriculture at Tokio, which, among other contents, includes a memoir on the embryology of silkworms, by Mr. K. Toyama.

IN the November issue of the *American Naturalist*, Prof. B. Dean continues the discussion of the origin of vertebrate limbs—this time from the point of view of the flotation and balancing of the body in the sharks. It is concluded that the pectoral, and not the pelvic, fins have shifted their position with the advance of development, in accordance with the exigencies of the physiological factors referred to, and it is urged that this affords strong evidence in favour of the lateral fold theory.

WE have to chronicle the appearance of a new biological serial, *Broteria*, issued by the College of St. Fiel, Lisbon, and named in honour of the celebrated Lusitanian botanist, Dr. F. d'Avellar Brotero, who died in 1887. Although the new journal will embrace biological subjects of any kind, its special object is the fauna and flora of the district immediately surrounding the College of St. Fiel. In addition to a number of papers not specially connected with the area in question, the present issue contains one on the Lepidoptera of St. Fiel.

THE Manchester Museum has issued a second edition, revised and enlarged by Dr. Hickson, of Prof. Milnes Marshall's admirable descriptive catalogue of the series of embryological models in the collection. Since the appearance of the first edition, the development of the torpedo has been added to the series. Number 9 of *Notes* from the Manchester Museum is devoted to observations on the nomenclature and identification of the British cephalopods, by Mr. W. E. Hoyle, reprinted from the *Journal of Conchology*. The author shows that the substitution of the name Polypus for the familiar Octopus, although much to be regretted, is inevitable, unless priority in nomenclature is to be altogether discarded.

"THE Solution of the Eel Question" is the title of a highly interesting paper, by Dr. C. H. Eigenmann, published in vol. xxiii. of the *Transactions* of the American Microscopical Society. After a summary of the investigations and discoveries of Grassi and Colandruccio in Italy in regard to the developmental history of the European eel, the author records the discovery of the larva ("Leptocephalus") of the American eel—a species which differs from its Old-World relative, both in the adult and immature condition, by the smaller number of vertebræ. In August, 1900, Dr. Eigenmann had the opportunity of examining some eels' eggs from the surface of the Gulf Stream—the first taken elsewhere than in Italy—which there is every reason for regarding as those of the conger-eel. To the larval form of the American eel, the author—somewhat unnecessarily, in our opinion—applies the name *Leptocephalus grassii*. In discussing the question whether eels ever breed in fresh water, the author states that while there is nothing inherently impossible in this, yet no decisive evidence of its occurrence has been hitherto recorded. No eels' eggs have at present been taken in fresh water, and the statement that eels found in land-locked basins must of necessity breed there is by no means conclusive.

WE have received a copy of *The Scientific Roll and Magazine of Systematised Notes* (Bacteria, vol. i. No. 6), conducted by Mr. Alexander Ramsay. It contains a few notes on various bacteriological subjects culled from various authors, and an essay on specific descriptions.

IN its issue for November 29, the *Lancet* publishes as a supplement an exhaustive account of the manufacture and nature of Cognac brandy. A number of analyses are given showing how brandy differs from other spirits and indicating how the genuine may be distinguished from the spurious. The former is the product of distillation and maturation of a grape wine, the latter is derived from potato or grain spirit. The subject is of considerable importance from a medicinal point of view.

THE Public Health Department of the City of London directs attention (Report of the Medical Officer of Health, No. 52) to the filthy and dangerous habit of indiscriminate spitting, the chief source, probably, of tuberculous infection. Many cities in the United States, Canada, Australia and in Europe have made the habit a penal offence, and the Corporations of Liverpool, Manchester and Glasgow and the County Council of Glamorgan have bye-laws prohibiting it in public places. The Medical Officer for the City suggests that similar powers should be obtained by the Corporation of London for dealing with it.

NEW editions have been published of "Palæontology, Invertebrate," by Mr. Henry Woods (Cambridge University Press) and "Maps, their Uses and Construction," by Mr. G. James Morrison (Edward Stanford). The former is the third edition and Mr. Morrison's book is a second edition, which has been revised and enlarged.

THE twenty-fourth annual volume of the *Proceedings* of the United States National Museum, published under the direction of the Smithsonian Institution, contains, like all its predecessors, an abundance of valuable information on anthropological, biological and geological subjects. It is impossible in this place to refer to each of the separate contributions. Messrs. Jordan and Snyder review many classes of the fishes of Japan, separate papers being given to the discobolous, gobioid, gymnodont, hypostomide, lophobranchiate, labroid, salmonoid and trachinoid fishes. Messrs. Wirt Robinson and M. W. Lyon provide an annotated list of mammals collected in the vicinity of La Guaira, Venezuela, while Dr. Leonhard Stejneger deals with the batrachians and reptiles of the same locality. In another paper, the last named author describes a new bullfrog from Florida and the Gulf Coast. Mr. D. White gives an account of two new species of algæ of the genus Buthotrephis, from the Upper Silurian of Indiana. The fossil fresh-water shells of the Colorado desert form the subject of a paper by Dr. R. Stearns. The humming-birds of Ecuador and Colombia are catalogued by Mr. H. C. Oberholser. Illustrations and descriptions of new, unfigured or imperfectly known shells, chiefly American, in the U.S. National Museum are given by Mr. W. H. Dall. The larks of the genus Otocoris are described in detail by Mr. H. C. Oberholser. Many of the papers are accompanied by numerous admirable illustrations, those connected with Mr. Oberholser's paper being especially good.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. E. Chaplin; a Virginian Eagle Owl (*Bubo virginianus*), a Mexican Eared Owl (*Asio mexicanus*) from Argentina, presented by Miss Irene Thornton; a Graceful Ground Dove (*Geopelia cuneata*) from Australia, presented by Miss Cooper; a Glass Snake (*Ophiosaurus apus*) European, presented by Mr. C. H. Rawlins; a Derbian Wallaby (*Macropus derbianus*) from Australia, deposited; four Black-necked Swans (*Cygnus nigricollis*) from Antarctic America, received in exchange.

OUR ASTRONOMICAL COLUMN.

NEW COMET 1902 *d* (GIACOBINI).—A telegram from Kiel, dated December 3, announces that the fourth new comet of this year was discovered by M. Giacobini at Nice on December 2d. 12h. Its position at 10h. 0m. (Nice M.T.) was R.A. = 7h. 17m. ·6, Dec. = 1° 58′ S., and it is moving in a north-westerly direction. A second telegram, dated December 4, says that the comet was observed by Herr Graff at Hamburg on December 3d. 11h. ·5, and its position for 15h. 0m. (Hamburg M.T.) was R.A. = 7h. 17m. ·4, Dec. = 1° 51′ S. The daily movement in declination is + 3′, and the projected path of the comet passes near to the border line between the constellations Gemini and Orion.

THE VARIABILITY OF α ORIONIS.—From an examination of his observations of the comparative magnitudes of Betelgeux and β Orionis which he has made during this year, Herr J. Plassman has confirmed the recent variation of magnitude in the former star, and he considers that the peculiarities of the variations merit further and continuous attention on the part of variable-star observers (*Astronomische Nachrichten*, No. 3830).

ACTIVITY OF THE LUNAR CRATER LINNÉ.—In *Circular* No. 67 of the Harvard College Observatory, Prof. E. C. Pickering gives the micrometric measures of the bright spot surrounding Linné which were made at Harvard by Prof. W. H. Pickering, using the 15-inch equatorial, before and after the passage of the earth's shadow in the eclipse of October 16.

These measures show that the bright spot has materially increased in size since similar measures were made in 1898 and 1899, and, further, that the change in size during the passage of the umbra was surprisingly great, so great that Prof. W. H. Pickering found it necessary to reassure himself that the object he was measuring was indeed Linné. This increase of size amounted to 2″·75, instead of 0″·14 obtained by the same observer during the eclipse of 1899 (*Popular Astronomy*, vol. viii. p. 58).

Prof. E. C. Pickering attributes the change in the normal size to increased activity on the part of the crater, and the large increase of diameter during the eclipse to the fact that, owing to this increased activity, there was on this occasion more moisture around the crater to condense.

The increase in normal size was confirmed by measures made on October 20, when the spot had begun to shrink owing to the increased amount of evaporation in the fierce sunlight, for the value obtained then (4″·61) was sensibly larger than that obtained (3″·41) during a similar phase in 1898.

REDETERMINATIONS OF THE VELOCITY OF LIGHT AND THE SOLAR PARALLAX.—A communication from M. Perrotin to No. 21 of the *Comptes rendus* describes the experiments which have been made recently, at the Observatory of Nice, to redetermine with greater accuracy the velocity of light, using the toothed-wheel method of Fizeau under improved conditions.

In previous experiments, the beam of light was made to travel a distance of 12km. (7·452 miles) and back, but in the recent experiments it was reflected from a mirror placed at a distance of 46km. (28·566 miles) from the source, an objective of 0·76m. diameter being used at the plane of emission and one of 0·38m. diameter as the collimator.

As a result of 1109 observations, the final value obtained for the velocity was 299,880km. (about 186,225·5 miles) per second, and the probable error is less than 50km. per second.

In addition, M. Perrotin also gives the final value obtained for the solar parallax, from observations of the planet Eros, made at Nice, as 8″·805 ± 0″·011, and from this deduces a value of 20″·465 for the "constant of aberration," thus confirming the value adopted by the International Astronomical Conference of 1896.

THE "ANNUAIRE ASTRONOMIQUE."—This year-book of astronomy for 1903, compiled by M. Camille Flammarion and published at the low price of 1·50 francs, is one of the most complete and useful books of its kind. It gives practically all the data required by the amateur astronomer or meteorologist, amongst which may be mentioned the solar, lunar and planetary elements for the year, the various phenomena such as eclipses, occultations, meteors, comets, &c., tables of the positions, distances and proper motions of the brighter stars, particulars of double stars, many useful meteorological tables, and a valuable *résumé* of the more important astronomical and meteorological events of 1902, the whole being freely illustrated by interesting photographs and curves.

METEOROLOGY AT GREAT ALTITUDES.[1]

AN International Aeronautical Congress was held at Berlin, May 20 to 24, 1902, on the occasion of the third meeting of the International Committee for Scientific Aëronautics, appointed by the Paris Meteorological Conference of 1896. Of this committee there were present the president, Prof. Hergesell, of Strasburg, Prof. Assmann and Mr. Berson, of Berlin, General

[1] Abridged from a Report contributed by Mr. A. Lawrence Rotch to the U.S. *Monthly Weather Review* for July.

Rykatchef and Colonel Kowanko, of St. Petersburg, Prof. Cailletet and M. Teisserenc de Bort, of Paris, and the writer, who is the American member. There were also present at the Congress, by special invitation, about one hundred military and civil aëronauts and representatives of meteorological institutions, the writer representing the United States Weather Bureau by request of its chief.

The opening of the Congress in the great hall of the Reichstag building was a brilliant event. Prince Frederick Henry of Prussia appeared for the Emperor of Germany. Both the Imperial and the Prussian Governments were represented, and the chief European nations, except France, sent the commanders or officers of their military balloon corps. After the usual formal greetings, the representative of the Prussian Minister of Instruction spoke as follows:—

"The Royal Government is much impressed with the importance and necessity of an exchange of ideas between the savants of all nations in matters concerning meteorology and terrestrial magnetism, since international cooperation in these branches of science is the indispensable forerunner of progress. This was indeed recognised as early as 1780, by the founding on German soil of the 'Societas meteorologica Palatina,' which undertook the task of beginning systematic weather observations in Europe, with the hope of extending them to other parts of the world. On account of the existing state of affairs, its efforts were of short duration and for a long time savants were allowed to labour independently, but with the foundation of magnetic investigations by Gauss and Weber, the sagacious idea of organisation acquired new life and pressed for realisation, especially through the development of navigation, which has the greatest interest in the accurate observation of weather phenomena on the ocean. The Antarctic discoveries of James Ross, and the successful efforts of American navigators to shorten ocean voyages, gave a new impulse, and so there arose the proposition of organising a meteorological service at the first congress of the maritime nations held at Brussels in 1854, although it was not until 1873, during the Vienna Exposition, that the first meteorological congress convened there laid the foundation of an international weather service. The international committee, appointed at that time, met at first annually, but later at intervals of two or three years. With its increasing activity, the necessity of dividing the work manifested itself, and thus special commissions were formed, of which one meets here to-day and whose third gathering will probably be as fruitful as its preceding meetings. In a field where there is only interest in research, may the bonds uniting the representatives of cultured nations ever become closer!"

In the name of the Prussian Meteorological Institute, its director, Dr. von Bezold, remarked that early investigators perceived the importance of aëronautics for meteorological researches. "When Charles, the inventor of the hydrogen balloon, made his first ascension in 1783, he took with him a barometer and a thermometer, as did the American aëronaut (Jeffries), who ascended from London during the next year. It was not until very lately that Germany took part in this work, or about the year 1880, but then, with an instrument markedly superior, namely, Assmann's aspiration-psychrometer, and through the munificence of the German Emperor, she was enabled to carry out the work on a large scale. For the second time, the representatives of scientific aëronautics now meet on German soil and thereby recognise the importance of our efforts. But much indeed has been done for this new research by M. Teisserenc de Bort at Trappes, near Paris, through the perfection of the *ballon-sonde*, the unmanned balloon carrying self-recording instruments, and by Mr. Rotch, of Blue Hill, through his application of kites. Both methods are so good that by their use a great impetus has been given to meteorological research, whereby it is easily understood that there should be uniform rules for their employment. Looking backward, it may be said that the international meetings for the organisation of meteorological research, in 1854 at Brussels, in 1873 at Vienna and in 1879 at Rome, are landmarks in the progress of the science, and that when, in September, 1896, the International Committee for Scientific Aëronautics was appointed, the plan had been so well considered and the technical necessity was so evident that there was entire unanimity in the deliberations and resolutions. The originator of the idea of the unmanned balloon was the late Gaston Tissandier, who enthusiastically explained the scheme to the speaker in 1886, although nearly ten years elapsed before its realisation. This work will be fruitful, for wind and clouds have no political boundaries and the sun belongs to us all. Consequently, we are all striving, for various reasons, toward the same goal, and the motto *viribus unitis* will be, as ever, the decisive measure of the result."

Prof. Cailletet, of Paris, responded for the foreigners present, and then Prof. Hergesell, after thanking the preceding speakers, said, in the course of his remarks:—

"Everywhere—in Paris, Strasburg, Munich, St. Petersburg and Berlin—aeronautical experiments for the scientific exploration of the atmosphere had taken place, and since a general wish was expressed to unite the separate efforts in a common cause, a favourable time to do this seemed to be in the autumn of 1896 at the conference in Paris of the directors of the meteorological institutes. France, the cradle of aeronautics, was the chosen ground, because there, independently of the German and Russian experiments, a most promising method of investigation had been developed that had already produced good results; for the French experimenters, Colonel Charles Renard and Messrs. Hermite and Besançon, all members of our Commission, had simultaneously put into execution the plan of exploring the highest strata of the atmosphere with free balloons carrying only self-recording instruments. Not the least service of our Commission has been to render the method of unmanned balloons comparable with the exact measurements in manned balloons as they are made in Berlin. During our first meeting, in April, 1898, at Strasburg, the difficult problem of obtaining a uniform instrumental equipment was solved in a general way. Since then, our manned balloons, here and abroad, carry the aspiration-psychrometer, which Dr. Assmann, in cooperation with the late Captain von Sigsfeld, has devised, and the unmanned balloons are provided with the normal registration apparatus which the indefatigable Teisserenc de Bort has constructed so skilfully. The registration balloon from that time has been the most powerful tool in dynamical meteorology and has furnished astounding data for the cold atmospheric strata up to a height of 20 kilometres, which are confirmed to a height exceeding 10 kilometres by the ascensions of the brave Berlin aeronauts, Berson and Süring, who have ascended so far in these regions. Since November, 1900, on the first Thursday of every month, simultaneous ascensions have occurred in Paris, Strasburg, Munich, Berlin, Vienna, St. Petersburg and Moscow, and on May 5, 1902, the 213th registration balloon of the International Commission was sent up. The observations have proved that the temperature does not steadily decrease upward, but that strata exist which often possess great differences of temperature. This stratification is one of the most important objects of the present investigation. And the future? Systematic meteorological research is at present carried on over only a small portion of the globe. Even in Europe, in the north there is lacking Scandinavia, and in the south Italy and Spain; but the presence of representatives of these countries at our meeting gives the hope of speedy cooperation. A plan for a meteorological cruise of a steamer to fly kites will also be discussed, for the meteorological exploration of the Tropics must be extended, and the participation of England in our endeavours gives us hope that India may be claimed as a region for investigation. *Per aspera ad astra*—that may be setting our goal too high, but, *per aspera ad altas et ignotas regiones*, up to the regions which hide the great secret where the weather comes from—that we certainly should fix as our goal."

At the second meeting, General Rykatchef, director of the Central Physical Observatory at St. Petersburg, spoke on the preliminary results attained with kites, *ballons-sondes* and manned balloons during the past five years in Russia. Scientific aeronautics in Russia date only from 1899, with the exception of some years of preparatory work. Still, there have been a large number of ascensions: 13 of the 60 kite-flights were above 3000 metres, while the *ballons-sondes* reached 14,200 metres. The inclement climate of Russia occasions many unusual difficulties, for instance, the kite wire on the reel becomes thickly coated with frost, rendering the unwinding difficult, or both wire and kites in the air are so thickly incrusted with frost work (five millimetres or more) that the kites often fall to the ground. Kites were used chiefly at the stations in Pavlovsk and St. Petersburg, and thereby special details were obtained in the lower strata of the diurnal and annual influence on the vertical decrease of temperature up to 3000 metres. It was found that in summer and during the daytime the decrease of temperature with increasing height proceeds more rapidly, and, on the contrary, that in winter

and during the night hours there are large inversions of temperature. In anticyclones, large inversions occur in the lower strata and a rapid decrease of temperature in the higher strata. General Rykatchef exhibited an anemometer, constructed by his assistant, Mr. Kusnetzof, for the registration of wind pressure during kite flights. The instrument has bridled Robinson cups which act like a dynamometer and record the gusts of wind on a revolving drum. In closing, the speaker announced that the Czar had given a considerable sum of money for the continuation of this investigation of the different strata of the atmosphere in Russia by means of balloons and kites.

M. Teisserenc de Bort, of Paris, presented the results of his observations of the decrease of temperature in the high atmosphere, as obtained from the ascensions of 258 *ballons-sondes*, which had reached or exceeded 11,000 metres, the total number of ascensions being 540, all of which were made at night to avoid the effect of insolation. The concordant and remarkable result is that, in the layer between 8000 and 9000 metres, the decrease of temperature becomes slower, ceasing entirely at 11,000 metres, while above that height a warming may set in, with fluctuations of 1° to 3° centigrade, making the temperature here on the average nearly constant. In the summer, this isothermal layer apears to lie somewhat higher, or between 13,000 and 14,000 metres. It is lower during the prevalence of a depression, but 4000 metres higher during a high pressure, so that the zone exceeds the height of the cirrus clouds. The lowest temperatures, occurring in a high pressure, were −67° and −72°, but in March the exceptionally low temperature of −75° centigrade was observed. Whether the absolute minimum of temperature has been reached here requires further proof, and as to the cause of this striking phenomenon there are only conjectures. Have we at these great heights aërial conditions working on a grand scale, where the cyclonic whirls of the lower atmosphere do not penetrate and the currents flow uninterruptedly?

Prof. Assmann said that the observations of the Berlin Aëronautical Observatory, although obtained by a somewhat different method, led to the same conclusion as that which had been reached at Trappes. Above 10,000 metres, the temperature oscillates and does not appear to decrease, although beyond the variable stratum, at 17,000 metres, and recently as high as 19,500 metres, the temperature was again found to decrease, so that the possibility of an absolute minimum of temperature is by no means excluded. The Berlin observations were executed with specially constructed balloons of Para rubber, which entirely avoided in the daytime the influence of solar radiation on the instrument, which was enclosed in double polished tubes.

Prof. Palazzo, Director of the Central Meteorological Office at Rome, announced that Italy would now participate in the international scientific exploration of the atmosphere. Through the aid of the Minister of Agriculture, three stations for kites are proposed; one on Mount Cimone (2165 metres), another on Etna (2942 metres) and a third outside of Rome, near the Fort of Monte Mario. The Minister of War has ordered that the ascensions by officers of the balloon corps shall take place on the days of the international ascents. Information was given about the observatory for the study of the physics of the atmosphere, now in construction on Monte Rosa at a height of 4560 metres, which is expected to be completed next summer. In connection with this communication, there was a discussion concerning the interest of scientific aëronautics in physiological investigations, which will form an important part of the work of the high-work observatory mentioned.

Prof. Assmann, Director of the Aëronautical Observatory of the Prussian Meteorological Institute, described his registration balloon of caoutchouc or Para rubber, which was one of the novelties of the meeting. The ordinary *ballon-sonde*, made of silk or paper and open at the bottom, has the great disadvantage that, when it approaches equilibrium in the upper strata of the atmosphere, its velocity of ascent decreases and the effect of insolation on the thermograph becomes greater, without it being possible to determine afterwards the place where the solar disturbance began during the ascent or where it disappeared during the descent; in fact, it is only in certain cases that we can distinguish between the insolation influence and the curious thermal anomalies that have been described by Teisserenc de Bort and Hergesell. The use of a closed balloon made of elastic material has this advantage, that in proportion as the enclosed gas expands, the ascensional force is increased, so that the balloon rises faster with augmenting height until it bursts, and then falls to the ground with diminishing velocity, because checked by a parachute. The meteorograph of Prof. Assmann has no clock movement, the time being unimportant; but a disc is turned by the metallic thermometer while the barometer draws a pen horizontally across the disc, and so the spiral curve indicates heights and corresponding temperatures. The apparatus exhibited weighed but 380 grams, and with the protecting basket 500 grams. Since ink would freeze at great elevations, the trace is made by a pen containing a solution of saltpetre, which writes on the disc coated with lampblack, treated with a solution of "tonsol." The chemical reaction gives a red trace that cannot be obliterated by handling or by immersion in water. The time required for an ascent to 15,000 metres is about one hour and for the descent two hours, so that the balloons do not travel very far and are usually recovered within three days. The diameter of the envelope at the start is 1 or 2 metres only, and it does not require to be completely filled with hydrogen to exert the necessary initial lift of 2 or 3 kilograms.

Dr. Valentin, of Vienna, spoke on the sluggishness of thermographs in registration balloons. Prof. Hergesell believed that it was better to employ the most sensitive and accurate thermometers rather than to try to determine the corrections for sluggishness. He exhibited such an instrument, as did M. Teisserenc de Bort. The French instrument has the Bourdon tube insulated by a block of hard rubber, which prevents the injurious conduction of heat. Comparisons between an instrument insulated in this way and one not insulated gave differences which increased with the height of the balloon and at 12,000 to 14,000 metres reached 6°, an amount that justified the insulation.

At the third meeting, the subject of kites and kite stations was opened with a paper by the writer on the exploration of the atmosphere over the ocean. The use of the kite on land is limited to favourable circumstances, since the wind must have a velocity of at least 5 or 6 metres per second to raise the kites and cannot exceed a certain maximum strength without endangering the wire by an excessive pull. At sea, however, the motion of a steamer at a velocity of 10 or 12 knots will almost always produce a suitable kite wind, if it does not already exist. In order to demonstrate this, in August, 1901, the writer crossed the North Atlantic on a steamer and found five out of eight days suitable for flying kites. Only on one day was the relative wind too light and on two days too strong, but the wind would always have been favourable had it been possible to alter the course of the vessel. These successful results led the writer to propose a meteorological kite expedition to the trade wind and equatorial regions of the Atlantic Ocean, where almost nothing is known of the upper currents. To defray part of the expense, application has been made to the Carnegie Institution for a grant of 10,000 dollars, but it was considered that the recommendation of the present Congress might aid in securing favourable action. Applause showed the approval of the meeting, which was voiced by Drs. von Bezold and Hergesell. The former, especially, pointed out the importance and the pressing need of meteorological observations over the ocean, where, in consequence of other methods of warming and cooling the air, very different conditions must exist than prevail over the land, and our ignorance of them is no longer to be tolerated. Prof. Köppen, of Hamburg, expressed himself in a similar manner, and made the interesting announcement that, according to the programme of the Scandinavian Hydrographic Congress to explore the Baltic and North seas in the interest of the fisheries, four cruises a year were proposed on which meteorologists would be given an opportunity to study the atmosphere above these seas. Prof. Wagner, of the University of Göttingen, said that the Göttingen Society of Sciences had, at the request of the Aëronautical Committee, furnished the geophysical expedition which was sent to Samoa about a year ago under the leadership of Dr. Tetens with kites and instruments, in order to obtain meteorological observations above that island and on the return voyage over the Pacific Ocean. Dr. Hergesell mentioned that on the Lake of Constance meteorological kite flights were to be undertaken, Count von Zeppelin furnishing the vessel and the meteorological service of Alsace-Lorraine the apparatus. General Rykatchef promised, on the part of the Russian Government, that similar observations would be executed over the northern portion of the Baltic as well as over the Black Sea. On the motion of Dr. Hergesell, the plan of Mr. Rotch for a meteorological

kite-expedition in the South Atlantic was fully approved, and the hope was expressed that, with the aid of Government funds, the project might be realised in the near future. Mr. Berson remarked that it was of the greatest importance that the British as well as the Dutch Governments should encourage meteorological observations in the monsoon region, and Major Trollope, speaking for Great Britain, said that he would endeavour to have this done.

M. Teisserenc de Bort showed a diagram of the results obtained from continuous soundings of the atmosphere, or those made as frequently as possible at his observatory at Trappes, viz., on thirty-six days in January and February, 1901, when kites and registration balloons (*ballons-sondes*) were sent almost daily into the higher atmosphere to an extreme height of 12,000 metres. The plotted results throw doubt on the assumption that the barometric depressions bring higher temperatures and the barometric maxima lower temperatures, and give an interesting demonstration of the diversity and complexity of the atmospheric phenomena of which it is the aim of international aëronautics to ascertain the laws.

The fourth meeting was principally occupied with the subject of high ascents, and an apparatus for breathing oxygen at great altitudes was shown by Prof. Cailletet.

Dr. Süring spoke on the ascension which he had made with Mr. Berson on July 31, 1901, to the height of 10,800 metres, the greatest height yet reached by man. He insisted upon the importance of such high ascents to control the observations otherwise obtained and to make those that require direct vision. Especially are the strata from 5000 to 10,000 metres not yet adequately explored, and for weather changes they are of great importance, as is indicated by the scarcity of clouds near 4000 metres and above 6000 metres.

Lieutenant von Lucanus, in the name of the German Ornithological Society, asked aëronauts to observe the various heights at which birds are found. It is now supposed that the height above the ground at which birds fly does not generally exceed 400 metres, and only occasionally reaches 2000 metres, the zone usually remaining below the lower clouds. Still, much uncertainty prevails concerning the tracks of birds, and especially the heights of flights, and information is greatly desired.

The fifth session was mostly devoted to a discussion of observations of atmospheric electricity and terrestrial magnetism in balloons. Prof. Hergesell explained that electrical measurements are of such vital interest that the academies of Berlin, Munich, Göttingen, Leipzig and Vienna were to have been represented at this meeting by Profs. von Bezold, Ebert, Wagner, Wiener and Exner. The latter, who is the Nestor of this branch of physics, was prevented from attending, but Prof. Elster, of Wolfenbüttel, was present among the experts. Prof. Ebert, of Munich, said that constituents containing electrical charges had been found recently in the air through their physical properties. These carriers of electricity are called "ions," or, more correctly, "electrons." At the earth's surface, their presence may be shown by the dissipation apparatus of Elster and Geitel, and the smallest quantity of electricity may be recorded by means of an electrometer. The speaker had adapted this apparatus for use in balloons, and, by employing an aspirator, a fixed quantity of air could be drawn over the dissipating body and absolute measurements made of the amount of free electricity contained in a cubic metre of air. It is of importance in geophysics to know how the capacity of the air for positive and negative electrons varies with altitude, and therefore the speaker had made such determinations, finding near the earth many more positive than negative electrons, but whether this is a result of the negatively charged earth is uncertain. In the high strata, the inequality tends to disappear, but considerations that throw doubt on the balloon observations relate partly to the electrical discharges produced by the ultra-violet light rays and partly to the indeterminate moment of aspiration in a rising or falling balloon. Prof. Ebert considered the cooperation of aëronauts valuable, and cited as a result of the investigation in the Alps that in the foehn wind an excess of positive electrons is found, and this disturbance of the electrical equilibrium perhaps may cause the foehn sickness. Prof. Elster described two experiments that proved the existence of the electrons, one being the radiation of Becquerel rays after two hours from an insolated and stretched copper wire charged with 2000 volts. It was agreed by both experts that the cleaner and clearer the air the more electrons it contains.

Before closing the Congress, the resolutions proposed, after undergoing certain modifications, were adopted by the committee in executive session, the Congress itself being only a consulting and advisory body. Besides the resolutions mentioned already, it was determined that the international ascents of balloons and kites during the next year should take place, as has been the case this year, on the first Thursday of every month, and that at least one of the *ballons-sondes* liberated at any station should be sent up one hour before sunrise in order that its records may not be affected by solar radiation, and also that the balloon may be seen when it falls to earth in the early morning. The Richard thermograph, with Teisserenc de Bort's insulating device, should be used, and the Hergesell instrument having a tube of German silver, instead of the Bourbon tube filled with alcohol, was also recommended on account of its sensitiveness and durability. Ascensions at other hours and with different apparatus are discretionary. The president, Prof. Hergesell, in summing up the results of the Congress, which he regarded as eminently satisfactory, laid special importance on the meteorological kite flights that were proposed over seas, lakes and mountains, and hoped that the British Government, by similar work in India, would help in the investigation of the great Asiatic monsoon region. A grant of money was requested from the German Government to enable the Prussian Meteorological Institute to cooperate with the writer in his proposed investigation of the atmosphere over the Atlantic Ocean. It was announced that in order to facilitate international researches in scientific aeronautics, the formation of an organisation, sustained by the various European nations, would be attempted.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—AN election will be held at Brasenose College in March, 1903, to an ordinary fellowship, of the value of 200*l.* a year, tenable for seven years, after an examination in the subjects recognised in the Honour School of Animal Physiology. Weight will be attached to work exhibiting research in some subject of physiological study.

The electors to Dr. Lee's readership in chemistry will appoint a reader in January, 1903, and they invite candidates to submit their names and qualifications before January 1. The reader must lecture in two at least of the three University terms, and, in addition to the duties performed for the University, he may be required, as an official student of Christ Church, to take part in the educational work of the house by giving lectures or other instruction in chemistry and directing the work of the chemical laboratory.

Convocation has granted 200*l.* to the Wykeham professor of physics to defray the expenses of fittings for his laboratory.

CAMBRIDGE.—The reader in geography and the lecturers in ethnology and geology have arranged for a series of lectures and practical courses to serve as a training for persons wishing to undertake exploration or desirous of contributing to our knowledge of foreign countries. The series will be held during the Lent term, and will include history of geographical discovery, principles of physical geography, map-making and map-reading, and geography of Europe, by Mr. Oldham; anthropogeography, practical ethnology, by Prof. Haddon; geomorphology and geology, by Mr. Marr; plane-table and photographic surveying, by Mr. Garwood; and elementary astronomical surveying, by Mr. Hinks. The courses will be open to members of the University and others. The fee for all is 3*l.* 3*s.* Further particulars may be obtained from Prof. Haddon, Museum of Archæology, Cambridge.

A syndicate has been appointed to consider what changes, if any, are desirable in the regulations that affect the mathematical portions of the pass examinations of the University, in particular of the previous examination. The members of the syndicate are:—The Vice-Chancellor, Mr. C. Smith, Prof. Forsyth, Dr. Hobson, Mr. W. L. Mollison, Mr. C. A. E. Pollock, Mr. W. Welsh, Prof. G. B. Mathews, Mr. S. Barnard, Mr. W. M. Coates, Mr. E. T. Whittaker and Mr. A. W. Siddons. It is probable that the syndicate will recommend changes analogous to those which have been introduced in connection with the University local examinations, especially as regards the dominance of Euclid.

THE council of University College, Liverpool, has appointed Major Ronald Ross, C.B., F.R.S., to the Sir Alfred Jones chair of tropical medicine and parasitology, recently founded with the aid of special subscriptions to the University fund.

AT a meeting of the general committee of the Principal Viriamu Jones memorial fund, recently held at University College, Cardiff, it was decided to raise a fund of 1000*l*. to erect a statue to the memory of the late principal. To carry out this object and to raise the necessary funds, an executive committee was appointed.

AT a meeting of business men of Manchester and district held on Monday, the Lord Mayor being in the chair, the following resolution was unanimously adopted:—"That the increasing competition and keenness of modern business life and its greater complexity call for a more thorough mental training of persons aspiring to be heads and managers of commercial and industrial establishments, and that this meeting heartily approves of the further development of the higher education bearing on commercial life now provided in the Owens College by the establishment of a Faculty of Commerce on the lines of the draft scheme now submitted."

THE prizes and certificates were presented to successful students of the Northampton Institute, Clerkenwell, on the evening of December 3, by the Lord Chancellor. The principal, Dr. Walmesley, reported a marked improvement during 1901 over the previous year in the number of medals and exhibitions gained in open competition by his students. Before the presentation of prizes, the Lord Chancellor said, in the course of a short address, that suitable technical education would enable the commerce of this country to achieve again the reputation which in some aspects had been diminished in modern times. In this matter, foreigners had been assisted by their Governments and had been provided with educational establishments at the expense of their countries.

THE fifth annual London conference of science teachers will be held on January 9 and 10, 1903, at the South-Western Polytechnic, Chelsea. At the first meeting, the chair will be taken by Mr. Henry Ward, chairman of the London Technical Education Board, and addresses will be delivered by Mr. Usherwood, on the experimental teaching of geometry, and by Mr. Frank Castle, on the teaching of workshop mathematics. Sir William Anson will preside at the second meeting, and addresses on the teaching of geometry will be given by Messrs. S. O. Andrews, W. D. Eggar and A. W. Siddons. Prof. Farmer, F.R.S., will be the chairman at the third meeting, when experimental plant physiology and the rational teaching of botany will be the subjects taken up by Mr. H. B. Lacey and Miss Lilian Clarke respectively. Prof. Callendar, F.R.S., will take the chair at the last meeting, when an address will be given by Mr. Newth on experimental illustration in the teaching of chemistry, and one by Mr. Busbridge on making lantern slides. Free admission to the conference will be granted to as many teachers as the room will accommodate, and application for tickets should be made to Dr. Kimmins, Dame Armstrong House, Harrow-on-the-Hill, or to Mr. C. A. Buckmaster, 16 Heathfield Road, Mill Hill Park.

WE announced last week that the name of Sir John Williams, Bart., had been mentioned in connection with the vacancy caused by Sir Michael Foster's resignation of his seat in Parliament as member for London University. Since then we have received a circular containing the invitation sent by a committee of graduates to Sir John Williams to become a candidate for the vacant seat, and the reply in which he accepts it. After referring to the new conditions of work of the reorganised University of London, Sir John remarks in his reply to the chairman of his committee, Sir J. F. Rotton:—"For the further development of the teaching side of the University and the realisation of our expectations with respect to its work, the creation of schools of original research is necessary. The gifts of generous donors do not and will not suffice to meet the expenses which they will entail, and I am of opinion that such schools form fitting objects of support from the State. Such establishments are a necessity for the growth of that scientific learning which is essential for the progress of trade and the prosperity of the country, as well as for the education of the community. Questions of public health—the prevention of epidemics, the securing of efficient vaccination, the housing of the people, the supply of unpolluted water, the disposal of refuse—engage the attention of Parliament from time to time; questions in the discussion of which the knowledge of those who have been trained in the laws of health and disease, and their application in practice, will prove of great value. To such I would give my earnest attention." Sir Philip Magnus has been asked by an influential body of graduates representing educational institutions to become a candidate for the seat, and has accepted the invitation. Both Sir John Williams and Sir Philip Magnus would give general support to the present Government as Unionists.

THE following announcements of gifts to higher education in the United States have been made in *Science* since the beginning of September:—Mrs. Phœbe Hearst's gifts for archæology and anthropology at the University of California amounted to 111,000 dollars during the last academic year. The University of Pennsylvania has received 100,000 dollars from Dr. E. W. and Clarence H. Clark for a chair in Assyriology, to which Dr. Hilprecht has been appointed. Dr. and Mrs. C. A. Herter, of New York City, have given 25,000 dollars to Johns Hopkins University. Dr. Howard A. Kelly has given 10,000 dollars for an extension of the gynæcological ward of the Johns Hopkins Hospital. Mr. John D. Rockefeller has offered to give 500,000 dollars to Teachers' College, Columbia University, on condition that the sum of 440,000 dollars be collected from other sources—190,000 dollars to pay the outstanding debts and 250,000 dollars for further endowment. The college has received from Mr. and Mrs. B. Everett Macy 175,800 dollars for the increase of the endowment funds and 98,709 dollars for the completion of the Horace Mann School. Princeton University receives 140,000 dollars under the will of the late Mrs. Susan Dod Brown. The bequest to the Princeton Theological Seminary made by Miss Mary Winthrop, of New York, amounted to 1,400,000 dollars. Yale University receives about 171,000 dollars as the residuary legatee of the estate of Mr. E. W. Southworth. The Ohio Wesleyan University receives 150,000 dollars under the will of the late Mr. Francis B. Loomis, of Cincinnati; and Vassar College receives 10,000 dollars by the will of the late Mr. Adolph Sutro, of San Francisco. Clark University will receive the sum of 1,577,000 dollars from the estate of the late Jonas G. Clark. This is in addition to the 500,000 dollars already paid on account of the collegiate department. These gifts and promises cover a period of three months and only include those known to have been made, yet they amount to nearly five million dollars, that is, about one million pounds.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 28.—Prof. S. P. Thompson, president, in the chair.—Prof. Perry read a paper on a slide-rule for powers of numbers. Soon after the reading of Mr. Lanchester's paper in 1895—the radial cursor: a new addition to the slide-rule—Prof. Perry made slides to assist in computing m^n, where m and n are any numbers. He then came to the conclusion that no great accuracy was obtainable; but on trying the method again, he has recently found that it is very convenient and sufficiently accurate for gas- and steam-engine work. These computations can be made with a table of values of log (log m) used in conjunction with an ordinary table of logarithms. In the rule exhibited, the D line is replaced by a scale such that the distance from the mark 10 to the mark m represents log (log m) to the same scale of measurement as that to which the distance from 1 to n on the C scale represents log n. The values of m range from 2 to 1000, and those of n from 1 to 10 or from 1 to ·1 used backwards. The author showed how, with one operation, the rule could be used to find the value of $m^{\frac{a}{n}}$, $m^{\frac{1}{n}}$, and the logarithm of any number to any base. If the answer on scale D is less than 2 or greater than 2000, or if the exponent n is negative, indirect methods involving two operations are necessary. Prof. Perry has replaced the ordinary D line by the log log scale, because in his opinion this line is the one least used by workers with the slide-rule. The use of the log log scale was described by Roget in 1814, and the author's object in bringing the matter forward lies in the fact that

Dr. Roget's paper seems to be almost unknown, and it is only in these modern days that the computations for which he invented the rule have to be frequently made.—Prof. H. L. Callendar exhibited a lecture experiment for the determination of the mechanical equivalent of heat. The experiment was carried out with a modified form of the apparatus exhibited and described by Prof. Callendar at the meeting of the Physical Society held on June 20.

Geological Society, November 19.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The Semna Cataract or Rapid of the Nile, a study in river-erosion, by Dr. John Ball. Inscriptions placed on the rocks at Semna, between the second and third cataracts, under the twelfth and thirteenth dynasties, serve as a means of gauging the local changes due to river-erosion during a period of about 4200 years. Horner, in 1850, came to the conclusion that "the only hypothesis which could meet the requirements of the facts observed would be either the wearing away of a reef or barrier at the place in question—a process requiring too long a period—or the existence at some distant period of a dam or barrier, formed perhaps by a landslip of the banks, at some narrow gorge in the river's track below Semna." The author is in favour of the former explanation. Rapid erosion with the formation of pot-holes is observed to be now taking place, and the author calculates that if 200 cubic metres (approximately 500 tons) of rock per year has been removed from the barrier, the lowering of it would amount to 2 millimetres a year, or in 4200 years 7·9 metres, the depth of the present river below the lowest group of inscriptions dating from the time of Amenemhat III. The yearly discharge of the Nile past Semna is nearly 100,000 million tons of water, and the author considers that the removal of 500 tons of rock under existing conditions in a year is not only not impossible, but highly probable, as all this erosion only amounts to 5 milligrams of rock per ton of silt-laden water. This erosion is compared with the classic instance of the River Simeto in Sicily. At Assuan and Silsilla, the river has suffered considerable lowering within geologically recent times, probably brought about by the removal of long pre-existent hard barriers. The sluices of the new dam at Assuan may in the future give a quantitative determination of silt-erosion in granite, and it would appear to be not difficult to ascertain at Semna the rate of pot-holing. The formation of new pot-holes 1½ feet deep, in an artificial channel in rock in Sweden, has been observed to take place in eight or nine years, and the author hopes in future to attempt some measurements of this kind at Semna.—Geological notes on the North-West Provinces (Himalayan) of India, by Mr. Francis J. Stephens. The country examined extends in a north-westerly direction across the line of strike, from the borders of Nepal and South-eastern Kumaon to north of the Alakmunda River in the vicinity of Badrinath and the Marra Pass. The summary of the author's observations leads him to "suppose that there are at least three distinct limestone or calcareous series in Kumaon and Garhwal, and that schists and quartzites, with several isolated patches of granitic rock, form a large part of the remaining formations."—Tin and tourmaline, by Mr. Donald A. MacAlister. The author gives a possible explanation of the reactions by which tin oxide could be separated from solution in magmas containing alkaline borates.

Mineralogical Society, November 18.—Dr. Hugo Müller, F.R.S., president, in the chair.—Mr. F. E. Lamplough contributed a note on proustite crystals, on some of which an unusual trigonal pyramid {73$\bar{3}$} is the dominant form, and on others the pyramid {9$\bar{4}$4}. These forms are associated with r{100}, e{011}, v{20$\bar{1}$}, a{10$\bar{1}$}, and in one case with {$\bar{1}\bar{1}$.7.7.}.—Prof. W. J. Lewis described crystals of mispickel and iron pyrites from the Binnenthal, and crystals of quartz and sphene from the Ofenhorn.—Mr. R. H. Solly gave an account of various minerals from the Lengenbach, Binnenthal. These included large crystals of baumhauerite differing in habit from those previously described by him and exhibiting several new forms, an unique crystal of binnite weighing more than 8 grams, and fine specimens of dufrenoysite partially covered by minute crystals of seligmannite. On the latter, ten new forms were observed, and from measurements made on twelve brilliant crystals the axial ratios were determined to be $a:b:c = 0·92332:1:0·87338$. The presence of copper was detected and the streak was chocolate-brown. Mr. Solly also discussed the crystallography of a presumably new mineral from the Lengenbach, five minute but brilliant crystals of which were found on a crystal of rathite. In these crystals, no plane or axis of symmetry could be determined, and each crystal was grown in a different position.—Mr. G. F. Herbert Smith exhibited a special form of protractor, and described the method of using it for plotting poles on a sphere in gnomonic projection and for determining the angles between poles and between zones graphically from the diagram.—Mr. G. T. Prior discussed the connection between the molecular volumes and chemical composition of some crystallographically similar minerals. He pointed out the chemical relationships (similarity in form of the chemical molecule with approximately the same number of atoms) of the members of the hamlinite-beudantite-jarosite group of rhombohedral minerals and showed that the molecular volumes exhibited an approach to equality. In the case of several sets of crystallographically-similar minerals, it was found that when the chemical formulæ were made similar in form by taking suitable multiples of the simplest formulæ, then the molecular volumes calculated for these new formulæ were approximately equal. On this principle, from the crystallographic similarity of rutile to zircon, of anatase to calomel and of brookite to tantalite and wolfram, the following formulæ for the three forms of titanic acid were deduced, viz. rutile (Ti_2O_4), anatase (Ti_4O_8), brookite (Ti_6O_{12}).—Mr. Prior also contributed a note on phonolitic rocks from St. Helena and Ascension. These were compared with similar rocks from the Great Rift Valley and from Abyssinia, and the striking uniformity of the volcanic rocks of the African continent was pointed out. It was suggested that this was only a part of a wider generalisation according to which the volcanic eruptions of the great Atlantic volcanic chain (including its two transverse European branches and the minor chain down the east side of Africa) are characterised by the association of basalts and alkali-rich phonolitic rocks, whereas andesites are the prevailing lavas of the two great Pacific chains.—Mr. L. J. Spencer described the crystalline form of carbides and silicides of iron and manganese, crystals of which had been placed at his disposal by Mr. J. E. Stead. He showed that crystals of the metallurgical products, spiegeleisen, ferro-manganese and silico-ferro-manganese, of which the general chemical formula is $(Fe,Mn)_3(C,Si)$, are of two kinds—(1) rhombic with a prism-angle of 67½°; (2) anorthic with a prism-angle of about 60°.

Linnean Society, November 20.—Prof S. H. Vines, F.R.S., president, in the chair.—Mr. R. Morton Middleton, gave an account of the dissertation by Linnæus on *Siren lacertina*, annotated by the author, which he had found in a dealer's possession and since then had been presented to the Society by the treasurer.—Mr. W. C. Worsdell showed a series of anomalous virescent flowers of *Helenium autumnale*, six strong plants in the garden at Friar Park, Henley, the residence of the treasurer, being thus affected.—Mr. H. E. H. Smedley exhibited large wax models of the fossil seeds of *Stephanospermum akenioides* and Lagenostoma, the latter occurring in the Lower Coal-measures of Lancashire; he also showed a model of a recent Cycad for comparison.—Rev. T. R. R. Stebbing, F.R.S., V.P., having taken the chair, the president reminded the Society that exactly a year ago he had the honour of giving an account of some observations upon the action of the enzyme contained in the secretion of Nepenthes. That enzyme, he then explained, not only possesses the property of peptonising the higher proteids (*e.g.* fibrin), but is also proteolytic, decomposing the proteid molecule into non-proteid nitrogenous substances such as leucin and tryptophane. The proof of this is afforded by the fact that liquids containing proteids that have undergone digestion give the tryptophane reaction; that is, a pink or violet colour on the addition of chlorine-water. Since that time, many other plants have been investigated with the object of ascertaining, (1) whether or not a digestive enzyme were present, and (2) of determining the nature of its action. In almost all cases, the presence of a proteolytic enzyme has been demonstrated. The experiments definitely establish the fact that an enzyme which actively proteolyses the simpler forms of proteid is present in all parts of the plant-body. But the question as to the precise nature of this enzyme still remains to be answered. Where proteolysis is accompanied by peptonisation, it may be inferred that the enzyme is allied to the trypsin of the animal body. Where no peptonisation, but only proteolysis, can be detected, it seems probable that the enzyme is allied to the erepsin recently discovered by Cohnheim in the small intestine. Possibly more than one enzyme may be active in certain cases. The conclusions arrived at depend entirely upon the trust to be placed upon the tryptophane reaction as evidence of proteolysis. From what is

known as to its chemical composition and as to the conditions of its formation in digestion, there can be no doubt that tryptophane is a product of the disruption of the proteid molecule. The point that had more particularly to be determined was whether the substance giving the colour-reaction with chlorine in these experiments is really tryptophane. The isolation of tryptophane is a difficult process, and was not attempted. The chemical identity of the substance is, however, established by the fact that its chlorine compound was found to give the same absorption spectrum as does that of tryptophane, namely, a band in the green on the yellow side of the thallium line.—Mr. A. G. Tansley gave an account of the relation of histogenesis to tissue morphology, dealing with a few points bearing on the relation of histogenesis at the apex of the stem in the Pteridophyta to the morphology of the tissue regions in the adult stem.—Mr. L. A. Boodle followed with a paper entitled "Stelar Structure of Schizæa and other Ferns."

DUBLIN.

Royal Irish Academy, November 10.—Prof. R. Atkinson, president, in the chair.—Sir Robert Ball, F.R.S., communicated a paper on the reflection of screws and allied questions. Let there be any system of straight lines and take any arbitrary plane S. Let P be a point on one of the straight lines, and let fall a perpendicular PT upon the plane S. Produce PT to P′ so that P′T = PT. Then the point P′ is the reflection of P. If we repeat this process for every point of the original system of straight lines, we obtain the reflected figure. The fundamental theorem is as follows:—The reflection of two reciprocal screws also forms a reciprocal pair provided the signs of the pitches of both screws be changed. From this we deduce the following theorems: (1) The reflections of a set of coreciprocal screws also form a set of coreciprocals; (2) the reflection of an n-system of screws is also an n-system.—Dr. R. F. Scharff read a paper on the Atlantis problem. After dwelling upon the historical aspects concerning the former existence of a continent beyond the Strait of Gibraltar known to the ancients as "Atlantis," Dr. Scharff referred to the attempts which had been made to solve this problem from a faunistic point of view. He disagreed with Dr. Wallace in his opinion that the fauna of the Atlantic Islands had been derived from occasional means of dispersal, and contended that the origin of their fauna was mainly due to former land-connections with Portugal and Morocco. The paper also dealt with the wider question of the existence of a land-connection between the Old World and the New in the same latitudes, the author maintaining that such a land-bridge had persisted until Miocene times.—Prof. C. J. Joly read a note on the multi-linear quaternion function in relation to projective geometry. When a quaternion is interpreted as a point-symbol, the equation $p=fq$ represents the general homographic transformation in space from one set of points q to another set p, f being a linear quaternion function. Also if f' is the conjugate of f, the equations $Sq(f+f')q=0$, $Sq(f-f')q'=0$, represent the general quadric surface and the general linear complex. Starting from these results, which were communicated to the Academy last year, the author proposes to consider the bilinear function $f(pq)$. The equation $p=f(eq)$ represents a homographic transformation when e is regarded as a constant quaternion, and by varying e, a four-system of homographic transformations is obtained the properties of which may be easily studied. The equation $p=f(qq)$ represents the general quadratic transformation. From a bilinear function $f(pq)$, five other fundamental functions may be obtained; the first and second conjugates, viz. the conjugates with respect to p and to q; the *promutate* $f(qp)$, and its first and second conjugates. The equation $Sqf(qq)=0$ represents the general cubic surface, and associated with this surface are systems of linear complexes $Sef(pq)=Sef(qp)$, just as the linear complex and the quadric are connected with a single function. The trilinear function $f(pqr)$ leads to similar results. In particular, if a and b are two constant quaternions, the equation $p=f(a, b, q)$ represents the complete group of linear transformations, any particular transformation being determined by suitable values of a and b.

PARIS.

Academy of Sciences, December 1.—M. Bouquet de la Grye in the chair.—On the temperature of inflammation and on the combustion in oxygen of the three varieties of carbon, by M. Henri Moissan. The temperature at which carbon enters into active combustion with oxygen differs with the variety of carbon, being higher as the carbon is more polymerised. Diamond becomes incandescent in oxygen between 800° and 875° C., graphite between 650° and 700° C., amorphous carbon between 300° and 500° C., but in each case the visible combustion is preceded by a stage during which the carbon is oxidised, this action taking place with a velocity which decreases the lower the temperature. Amorphous carbon is slowly oxidised in either moist or dry oxygen at a temperature as low as 100° C. —Experimental researches on adrenaline, by MM. Ch. Bouchard and Henri Claude. Experiments carried out with rabbits showed that the injection of 0·5 milligram of adrenaline per kilogram of body weight, and in one case as little as 0·2 milligram, was rapidly fatal. The animals survived a dose of 0·1 mgr. per kilogram, and it was found possible, by gradually increasing the amount injected, to diminish the susceptibility to the toxic effects of the adrenaline.—The heart in its normal state and during pregnancy, by MM. Ch. Bouchard and Balthazard. The orthogonal projection of the heart was traced by the aid of the X-rays and a fluorescent screen in forty-nine subjects, and a preliminary table of the results is given.—Observations regarding physiological injections, by M. Yves Delage. The injection of colouring matters such as ammonium carminate and indigo carmine for localising with precision the excretory functions is regarded as being likely to lead to fallacious conclusions. The colouring matters used are not normal excretion products, and because in certain animals some of these substances are eliminated by the normal organs of secretion, it does not follow that this is always the case. The line of argument strictly followed out would even lead to the conclusion that the nervous system is excretory because it fixes methylene blue.—On the Laplace-Abel integral, by M. G. Mittag-Leffler.—On the conditions necessary for the stability of equilibrium of a viscous system, by M. P. Duhem.—The tracing of pressure curves, by M. E. Vallier.—M. Deslandres was elected a member in the section of astronomy in the place of the late M. Faye.—On some consequences of certain developments in series analogous with trigonometric expansions, by M. W. Stekloff.—On some congruences with several unknowns, by M. R. Levavasseur.—On a generalisation in continued fractions, by M. Auric.—On uniform transcendentals, defined by differential equations of the second order, by M. R. Liouville.—A method of evaluating temperatures in the thermodynamic centigrade scale, by M. Ponsot. The method suggested by M. Pellat requires the simultaneous measurement of three magnitudes, the electromotive force of a thermoelement, the Peltier effect at one of the junctions and the temperature of this junction in an ordinary thermometric scale. The method suggested by the author is simpler as the latter determination is dispensed with.—The acceleration of gravity on the mean parallel, by M. J. Collet.—On the composition of gaseous hydrates, by M. de Forcrand. By the application of the thermodynamical method indicated in previous papers by the author, the probable formulæ of the hydrates of various gases are calculated; in nearly all cases, the hydrate has six molecules of water.—The transformation of pyrophosphoric acid into orthophosphoric acid, by M. H. Giran. By cooling syrupy pyrophosphoric acid down to −10° C. for three months, the acid was obtained in the crystallised form, and this was used for new thermochemical determinations.—Manganese aluminate, by M. Em. Dufau. By heating a mixture of alumina and oxide of manganese in the electric furnace, an aluminate identical with that previously described by Ebelmen is obtained, which on analysis proved to have the composition Al_2O_4Mn. It formed clear yellow transparent octahedral crystals, and although stable under conditions of ordinary temperature, is readily oxidised when heated in contact with air.—On the estimation of manganese, by M. H. Baubigny. An account of the precautions required for the estimation of manganese in acid solution by means of ammonium persulphate.—The action of bromine and chlorine on the mononitro-veratrols, by M. H. Cousin. In this paper, the constitutional formulæ of a certain number of trisubstituted derivatives of pyrocatechol and its methyl esters are determined, and two new nitro-derivatives are described.—On the reduction of acetol, by M. Andre Kling. The action of several reducing agents upon acetol was studied under various conditions, and the results lead the author to conclude that the constitution usually assigned to this compound is not correct, and that its constitution is better explained by the formula $\underset{\diagdown O \diagup}{CH_3{\cdot}C(OH){\cdot}CH_2}$.—The action of

fatty amines upon the dibenzoate of ethylene, by M. Marcel Descudé.—The action of halogen esters upon ammonim thiosulphocarbamate, by M. Marcel Delépine.—On the ichthyological fauna of the fresh waters of Borneo, by M. Léon Vaillant.—On the fishes of the Chondrostome group in the fresh waters of France, by M. Louis Roule.—The morphological and anatomical variations presented by the gizzard in some Coleoptera, by M. L. Bordas.—On the polychætal annelids in fresh water, by M. Ch. Gravier. Excretion in the Cirripedes, by M. L. Bruntz.—The application of a character of ethological order to the natural classification, by M. L. Matruchot.—The distribution of sphærulins in vegetable families, by M. Louis Petit.—The present state of the volcano of Martinique, by M. Lacroix.—On the evolution of the spermatid in the *Notonecta glauca*, by MM. J. Pantel and R. de Sinéty.—On the presence of paranucleolar acid corpuscles in the cells of *Locus niger* and *Locus coerulens*, by M. G. Marinesco.—The ratio of the weight of the liver to the total weight of the animal, by M. E. Maurel. Adult animals have less liver per kilogram weight than young animals of the same species. In the same species of animal, when differences of volume correspond to different varieties, as in the dog, the quantity of liver per kilogram of animal is higher as the animal is smaller. This proportion also varies with the nature of the food.—On the variations of phosphorus in animal tissue, by M. A. L. Percival.—Physiological researches on the effects of cervical sympathicectomy, by MM. Moussu and Charrin.—Muscular hæmoglobinuria, by MM. Jean Camus and P. Pagniez.—On the formation of the *anticorps* in the serum of vaccinated animals, by MM. A. Calmette and E. Breton.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—On Certain Properties of the Alloys of the Gold-Silver Series: The late Sir William Roberts-Austen, F.R.S., and Dr. T. K. Rose.—The Spectrum of γ Cygni: Sir Norman Lockyer, F.R.S., and F. E. Baxandall.—Abnormal Changes in some Lines in the Spectrum of Lithium: H. Ramage.—Quaternions and Projective Geometry: Prof. C. J. Joly.—An Error in the Estimation of the Specific Gravity of the Blood by Hammerschlag's Method, when Employed in Connection with Hydrometers: Dr. A. G. Levy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Photometry of Electric Lamps: Dr. J. A. Fleming, F.R.S.

SOCIETY OF ARTS, at 4.30.—Domestic Life in Persia: Miss Ella C. Sykes.

INSTITUTE OF ACTUARIES, at 5.30.—Lecture on Statistics (Measurement of Groups): A. L. Bowley.

MATHEMATICAL SOCIETY, at 5.30.—(1) The Integration of Linear Differential Equations; (2) The Determination of the Finite Equations of a Continuous Group: Dr. H. F. Baker.—The Expression of the Double Zeta and Gamma Functions in Terms of Elliptic Functions: G. H. Hardy.—Sets of Intervals. Part II., Overlapping Intervals: W. H. Young.—Series connected with the Enumeration of Partitions: Rev. F. H. Jackson.—The Abstract Group simply Isomorphic with the Group of Linear Fractional Transformations in a Galois Field: Prof. L. E. Dickson.—The Continuation of the Series for arc sin x: Prof. M. J. M. Hill.—The Functions associated with the Parabolic Cylinder in Harmonic Analysis: E. T. Whittaker.

FRIDAY, DECEMBER 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Ephemeris for Physical Observations of Jupiter, 1903–1904: A. C. D. Crommelin.—Cape Double Star Results, 1902: R. T. A. Innes.—On Jacobi's Method of Facilitating the Numerical Solution of Equations arising in the Theory of Secular Perturbations: H. C. Plummer.—Note on Binding Together Réseaux and Plates: J. A. Hardcastle.—*Promised paper*:—Distribution of Stars as derived from a Discussion of the Bonn, Schönfeld and Cape Photographic Durchmusterungs: F. A. Bellamy.

PHYSICAL SOCIETY, at 5.—A Portable Capillary Electrometer: S. W. J. Smith.—On Astigmatic Aberration: R. J. Sowter.—Experiments on Shadows in an Astigmatic Beam: The President.—Vapour-Density Determinations: Sir W. Ramsay, F.R.S., and Dr. B. B. Steele.—A Lecture Experiment on Gaseous Diffusion: Prof. L. R. Wilberforce.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Bearing of Outbreaks of Food Poisoning upon the Etiology of Summer Diarrhœa: Prof. Sheridan Delépine.

MONDAY, DECEMBER 15.

SOCIETY OF ARTS, at 8.—The Future of Coal Gas and Allied Illuminants: Prof. Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in North-west Mexico: Carl Lumholtz.

TUESDAY, DECEMBER 16.

ROYAL STATISTICAL SOCIETY, at 5.—English Railway Statistics: W. M. Acworth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Rupnarayan Bridge, Bengal-Nagpur Railway: S. Martin-Leake.

WEDNESDAY, DECEMBER 17.

CHEMICAL SOCIETY, at 5.30.—A Reagent for the Identification of Carbamide and of certain other Nitrogen Compounds: H. J. H. Fenton.—The Rate of Decomposition of Diazo-Compounds. Part II., Diazo-Compounds of the Naphthalene Series: J. C. Cain and F. Nicoll.—(1) The State of Carbon Dioxide in Aqueous Solution; (2) Qualitative Separation of Arsenic, Antimony and Tin: J. Walker.—The Hydrates and Solubility of Barium Acetate: J. Walker and W. A. Fyffe.—The γ β-Dimethylglutaric Acids, and the Separation of Cis- and Trans- Forms of Substituted Glutaric Acid: J. F. Thorpe and W. J. Young.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Climate of Cyprus: C. V. Bellamy.—The Eclipse Cyclone of 1900: H. Helm Clayton.

GEOLOGICAL SOCIETY, at 8.—Note on the Magnetite-Mines near Cogne: Prof. T. G. Bonney, F.R.S.—The Elk (*Alces machlis*) in the Thames Valley: E. T. Newton, F.R.S.—Observations on the Tiree Marble, with Notes on Others from Iona: A. K. Coomáraswámy.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Genus Diaschiza: F. R. Dixon-Nuttall and Rev. R. Freeman.—A New Arrangement for Taking Photomicrographs in Colours: E. R. Turner.

SOCIETY OF ARTS, at 8.—The South Russian Iron Industry: Archibald P. Head.

THURSDAY, DECEMBER 18.

LINNEAN SOCIETY, at 8.—Notes on Copepoda from the Faeroe Channel: Thos. Scott.—Amphipoda of the *Southern Cross* Antarctic Expedition; Alfred O. Walker.—The Deep-Sea Isopod *Anurus branchiatus*, Bedd.: Dr. H. J. Hansen.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes of Recent Electrical Designs: W. B. Esson.

FRIDAY, DECEMBER 19.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electricity Supply from Double Current-Generators: P. R. Wray.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands: J. N. S. Williams.

CONTENTS.

THURSDAY, DECEMBER 18, 1902.

PROF. GIGLIOLI'S COLLECTION ILLUSTRATING THE STONE AGE.

Materiali per lo Studio della "Età della Pietra" dai tempi preistorici all' epoca attuale. Origine e sviluppo della mia collezione. By Enrico Hillyer Giglioli. Pp. 248. (Florence: S. Landi, 1901.)

THE publication of a detailed description of the private collection formed by Prof. Enrico Giglioli is a welcome and important event, and one to which students of archæology and ethnology have long looked forward. Even to those who have not enjoyed the privilege of visiting Prof. Giglioli at home and seeing his treasures, it has been known by many indications that a scientific collection of no ordinary calibre was being brought together by the energetic professor. The actual wealth of material accumulated, as revealed by the present publication, is, however, somewhat startling, and one can but admire the perseverance and success with which he has pursued his hobby. One must refer to his studies and investigations in the fields of archæology and ethnology as a *hobby*, since Prof. Giglioli is a zoologist by profession, his official time being occupied in his professorial duties and his work as director of the important Zoological Museum in Florence. His private collection and the studies connected with it are the results of his leisure time labours, and one may readily infer that he has never indulged in that doubtful luxury "an idle moment." "Chi vive lavorando non ha mai tempo abbastanza," he laments, but he has utilised his available time to the utmost, by methodically devoting his daytime to zoology and his evenings to his collection. In the formation of his very extensive collection, he has kept always in view the definite object with which in 1883 he commenced to collect. His primary aim has been throughout to elucidate so far as possible the "Age of Stone" by means of comparative study; and to this end it has been his endeavour to secure as complete a collection as possible of objects illustrating, not only the life and arts of prehistoric Stone-age man in all countries, but also the conditions of culture of recent savage and barbaric races, whose developmental progress has from various causes been arrested or retarded, and who, therefore, may be regarded as *survivals* from various early stages in the general development of the human race. The bringing together of archæological and ethnological material into close association for purposes of scientific study, to the end that the specimens in the one class may serve to elucidate those in the other, has now long been recognised as of the greatest scientific value. Colonel Lane Fox and Mr. Blackmore were early pioneers in this field of inquiry, and the lessons which they taught still hold good and are increasingly appreciated.

Prof. Giglioli's publication is primarily a descriptive guide to his private collection, drawn up methodically under geographical headings and subheadings. The work is, however, more than a mere detailed catalogue, as its scientific value is enhanced by a running commentary of considerable interest to the archæological and ethnological student. While approving the general form and scope of the work, one cannot but note one serious defect, tending greatly to reduce the utility of this otherwise valuable guide. There is no index to contents. A work of this nature should certainly be furnished with a good index; it should, in fact, be doubly indexed, on the one hand under geographical, and on the other under subject headings. The labour of producing the index would be well repaid by the appreciation with which this important feature would be received, and we may still hope that the author will issue an index in full which may be bound up with the work. There are several very fair illustrations in the text. It would be impossible within the limits of a short notice to give an idea of the richness of this collection. Many of the rarer objects are represented by good series, as, for instance, the New Zealand *hei tiki*, of which there are ten of nephrite, one, perhaps unique, of diorite, and others of bone. There are no fewer than 177 *toki* or stone adzes from the same region. Witness also the remarkable series of hafted stone axes from South America and the thirty-two ceremonial adzes with elaborately carved handles from Mangaia. Among the less rare forms, the numbers run high, and there are no less than 325 stone adzes and chisels from the New Guinea region. Both the art of war and the arts and industries of peace are well illustrated. Many of the uncommon localities which are included in the very comprehensive list of carefully localised specimens are but very rarely represented in even the more important museums, a fact which would of itself place this collection in the front rank. In his descriptions, Prof. Giglioli has given brief notes upon the races and tribes dealt with their geographical position, &c. Wherever possible, he has given the native names of the objects, and details as to manufacture and other points of interest are touched upon, rendering the work (especially if indexed) a valuable book of reference to ethnologists and collectors.

One may readily endorse the hopes expressed by the maker of this remarkable collection that it may eventually find a permanent home in a public museum and be preserved in its entirety. It would be almost a crime to allow the dispersal of a collection so complete and so systematically and laboriously brought together.

EXPLOSION MOTORS.

Les Moteurs à Explosion. By G. Moreau. Pp. xii + 444. (Paris: Libraire Polytechnique, Ch. Béranger, 1900.)

Théorie des Moteurs à Gas. By G. Moreau. Pp. 224. (Paris: Ch. Béranger, 1902.)

THE extraordinary developments which have attended the application of explosion engines to motor vehicles, and the rapidity with which the constructors of these light and powerful engines have carried their designs well within measure of practical perfection, forms one of the most noteworthy achievements of modern engineering.

The time has, however, arrived when practice must be tempered with a sound knowledge of theory, in order that further advances along the existing lines of construction may be achieved.

With this object in view, M. Moreau has compiled two

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volumes in which the theory of explosion motors and the nature of the combustibles used therein are detailed in a thoroughly clear and systematic manner. The two volumes cover to a certain extent identical ground, but in the earlier work the subject is treated in its widest sense and the mechanical features of the motor vehicle as a whole are freely investigated; while in the later work the author confines himself exclusively to the engine, and here brings the theory of the subject well into line with the latest developments in practice, at the same time indicating the directions in which further improvements may be arrived at.

In the earlier work, the opening chapter is devoted to purely theoretical considerations of motors operating with perfect gases, and the laws regulating the behaviour of such gases under varying conditions of pressure and temperature. The imperfections of the gases actually available in practice are then considered, and the working conditions of the various cycles which may be employed are investigated. A chapter is devoted to the question of the specific heats of gases under various conditions, the question of the rate of the explosion relative to piston velocity, and the losses in actual engines due to throttling at the inlet and exhaust, to the cooling of the cylinder walls and to heat rejected on exhaust; representative diagrams are given and the total losses discussed.

Three chapters are then devoted to questions connected with the mechanical design of engines and motor vehicles, such points as the movements of the piston, connecting rod and crank-pin, valve movements, frictional losses and the strength of materials being fully discussed. All the chief organs of the transmission gear and special items such as axles, wheels, brakes, pneumatic tyres, carburettors and ignition apparatus are dealt with in detail, the author carrying his investigations in this portion of the work far beyond the limits indicated by its title. The nature and properties of the various combustibles which are available for explosion motors are next fully considered, the author remarking with much truth on the extraordinary ignorance amongst constructors on this particular branch of the subject. The work concludes with a comparison of trials of motors and automobiles, and considerations relative to the most suitable cycle to employ, the author advocating a six-stroke cycle —namely, admission, compression, expansion, recompression, explosion, exhaust—the advantages gained being a better mixture, re-heating of the charge after it has entered the cylinder, and abstraction of heat from the walls, which would diminish the loss to the cooling water.

In the more recent volume, which is based on a series of lectures delivered before the Automobile Club of France, the functions of every type of explosion engine which may be employed on a motor vehicle are investigated in a systematic manner. All the most important points in the design of engines, such as the volume of the compression chamber relative to the total cylinder volume, the influence of the walls, of the periods of admission and exhaust, and of the propagation of the explosion are carefully considered.

The concluding chapter, which forms nearly one-third of the volume, is devoted to the nature of the combustibles which may be employed, to the best conditions for the running of an engine and to investigations of the inertia of the reciprocating parts.

The subject in both volumes is handled in the clearest possible manner, and although higher mathematics is freely employed in every investigation, each step is so carefully traced that the author may be followed to his conclusions by all who possess a practical knowledge of the subject of explosion engines.

C. R. D'ESTERRE.

MARIGNAC AND HIS WORK.

Œuvres complètes de Jean-Charles Galissard de Marignac. By E. Ador. Tome i., 1840–1860. Pp. lv + 701. (Genève: Eggimann, n.d.)

THIS edition of the works of Marignac is prefaced by a biographical sketch by his son-in-law, Prof. Ador. From this sketch, we learn that Marignac, a native of Geneva, came of a scientific stock; at the house of his uncle, Le Royer, he early made the acquaintance of distinguished men, of whom there has been no lack in his native town. Prévost, De Candolle and Dumas were frequent guests in Le Royer's pharmacy, and from them young Marignac imbibed that single-hearted devotion to science which so strongly characterised him. He began his career, not as a chemist, but as an engineer; he was a pupil of the École Polytechnique, and later of the École des Mines, at Paris. His talents had so strongly impressed the French authorities, however, that long after he had ceased to be connected with France and had accepted his chair at Geneva, the French Government expressly granted to him the right to keep the title "Ingénieur des Mines," in spite of his having ceased to be a French subject.

In 1840, when twenty-three years of age, he came under the magnetic attraction of Liebig and passed a semester at Giessen; and it bears high testimony to Marignac's genius to find that after that short probation he was offered, and accepted, the much-coveted post of chemist to the porcelain factory at Sèvres. He occupied the position only six months, and on receiving a call to fill the chair of chemistry in the Academy of Geneva (for the University had not at that time been created), he at once accepted, finding his life work in an academic career. As professor there, he lived and died, although in 1878 he withdrew from active teaching. Never robust, he succumbed gradually to an insidious disease, and he died in 1894, after a long and tedious illness, borne with the utmost fortitude. His lectures were models of method and clearness—indeed, these were the characteristic features of all his work—and his modesty, patience and perfect conscientiousness gained for him the esteem of the whole scientific world, testified by the numerous honours which fell to his lot.

His only researches in the domain of organic chemistry, no doubt suggested while in Liebig's laboratory, dealt with phthalic acid and the action of nitric acid on naphthalene. It was at Geneva that he began the series of investigations on atomic weights which have rendered his name famous. The inducement was to test Prout's law; and the ratio between the atomic weights of chlorine, potassium and silver first occupied his attention. His attempts to prepare pure material for experiment

led him to undertake numerous subsidiary investigations, some dealing with isomorphism, some with the diffusion and specific heats of salt-solutions. His researches on the double salts of fluorine and potassium with silicon, titanium, tungsten, zirconium, niobium and tantalum, and on the rare earths were all part of his scheme to ascertain the true relations between the atomic weights of the elements. During the forty-five years of his scientific activity, he determined the equivalents of no fewer than twenty-eight elements. Besides these labours, he added to our knowledge of ozone and conducted experiments with Foucault's pendulum.

M. Ador's sketch of Marignac gives an interesting summary of this work, adding also a sketch of the part which he took in developing the modern aspect of chemistry, in adopting the now familiar means of deducing atomic weights from the equivalents determined by analysis.

The present volume is the first of a series of reprints of Marignac's original papers, most of which were published in the "Archives de la Société d'Histoire Naturelle de Genève." The typography and arrangement leave nothing to be desired, and M. Ador has conferred a benefit on his fellow-workers by the labour of love which he has so successfully carried out, and has paid the best possible tribute to the revered memory of his old master. W. R.

A MANUAL OF PHYSICAL GEOGRAPHY.

An Introduction to Physical Geography. By Grove Karl Gilbert and Albert Perry Brigham. Pp. xvi + 380. (London: Hirschfeld Brothers, Ltd., 1902.) Price 5*s.* net.

IT might reasonably have been supposed that there was no field in the United States for a new concise manual on physical geography. Yet the cooperation of one of the most original observers of geological phenomena with the practical teacher of geology in Colgate University has given us a book that we should be very sorry to lay aside. It has, like many of its rivals, been brought unmodified into the English market, where it will appeal to teachers rather than to junior scholars. It would be, indeed, no more suited, with its wealth of American illustration, to European classes than Huxley's description of the Thames Valley would be to dwellers on the Mississippi or the Hudson. But in the continent of North America this little book should take a foremost place. The abundant photographic illustrations are excellent and well chosen. They are not reduced, as in some small text-books, to blurred patches which suggest no natural landscape. The process-blocks seem to us to vary slightly in grain, whereby some of the smaller ones have been brought to a rare degree of delicacy; the sand-ripples on the dunes in Fig. 83 will serve as an example. To name two other suggestive pictures, the contrast of delta and cliff in Fig. 37, and the geognostic details of the "creeping" rock-surface in Fig. 59, are especially well presented.

The style of the text forces the meaning of the illustrations on the reader. The same firmness appears in Mr. Gilbert's "Geology of the Henry Mountains" and "Lake Bonneville," but the effect is there modified by a far more classical terminology. Whether or no joint authorship is responsible for the diction in the present book, the result may be commended as a consistent work of art. These short, direct, eminently English sentences are not easy to write, but are delightful to read and are perfect for their purpose.

The current system of importing American books intact under the name of a London publisher leaves us, even in this case, with such spellings as "oxid" and "sulfur," and such antique words as "sled." While Prof. Brigham writes "bowlder," the joint authors, however, give us our own form, "boulder." "Glen" and "dale" may be, as stated on p. 28, "somewhat poetic" in America, where "gulch" is common, but they are fortunately familiar to every hillman in our islands. Yet these are trifles in a book that appeals to us as much by its style as by its subject.

The authors conceive geography (p. 13) as a comprehensive knowledge of the earth, and their book as a first book of science, similar, we take it, to Huxley's "Physiography." They attract attention to the features seen in any walk across the country, and correlate these with the striking phenomena of high mountain regions, volcanoes, and so forth. On p. 209 the recent eruptions in Martinique are judiciously introduced.

There is little experimental method in the book; the rain-gauge, for instance, is mentioned, without any statement of how a reading can be made in actual practice; the chemical characters of limestone are given, without a hint of how the material may be interestingly dealt with by the pupil. The teacher will, however, supplement the book in these matters, and its clearness of description cannot fail to give him new conceptions. What can be better, for instance, than the remark (p. 279) that "the ocean may be likened to a film of liquid clinging to the outside of a spoon"? We should like to quote some of the more vivid passages, such as the contrast between life in the Alps and in the Rocky Mountains on pp. 191–2. We do not agree with the authors in their discussion of passes in the Pyrenees and Alps, or as to "the somber skies of Germany" (p. 195), when Baden and Bavaria are referred to; but we should probably be far more at fault were we to illustrate—or, as the authors say, "illuminate"—a European text-book by remarks on Georgia or Colorado. GRENVILLE A. J. COLE.

A PICTORIAL ARITHMETIC.

The Modern Arithmetic. Primary and Elementary Grades. By Archibald Murray, A.B. (Harvard). Woodward Series. Pp. 308. (St. Louis, U.S.A.: Woodward and Tiernan Printing Co.)

THIS is a book for the use of a teacher of very young pupils. It is divided into three parts. Part i. (82 pages) is concerned with "number exercises," and consists of thirty-eight lessons, each one of which we may suppose to occupy the child for one day. Each of these lessons consists of a series of questions or directions given to the pupil, such as "hold up seven fingers," "find, by using splints, the half of ten units," &c. A marked feature of this part of the book is the beautiful series of coloured pictures of roses, apples, grapes, strawberries, oranges, finches, redbirds and other interesting

objects which it contains, while the interest and curiosity of the young pupil are further secured by a good drawing of a spider and his web, as well as by an excellent picture of a pair of boots.

This part of the book deals, then, as the author says, solely with ideas of comparison, measurement and counting. The extent to which we get in part i. may be inferred from the last two questions or problems in it :—

"A book cost 3 dimes, a pencil 3 cents, and a blank book 3 nickels. How many cents did all three cost? Count from 1 to 30; from 5 to 100 by fives. Count as high as you can by hundreds."

Part ii. treats of the elementary operations—addition, subtraction, multiplication, division—and the meaning of fractions (halves, thirds, quarters, &c.) is gradually unfolded during these operations. The pictorial method is continued in this part, but the pictures are of the geometrical kinds that we get by cutting out and folding paper, so that the measurement of simple areas and the nature of an angle are explained to the little learner. Thus, one of the things here learnt by folding is that the sum of the angles of every triangle is two right angles. Near the end of this part, the nature of a decimal is explained, and the extent to which the pupil has progressed may be seen by the following, taken from the last lesson in part ii. :—

"At the rate of 56 miles per hour, how far will a train travel in 5·6 hours? A bookseller paid \$$9\frac{3}{4}$ for books. How many did he buy if each cost \$$\frac{3}{8}$?"

Part iii. treats of "elementary operations classified," that is, the operations of part ii. are treated more in detail and the philosophy of the subject is expounded. Near the end, the nature of ratio and proportion is explained, instruments, such as a two-foot rule, being employed. Among the terminal problems in this part are the following :—

"Express 9 cu. yd. as a decimal of a cord" (from which we conclude that the author does not anticipate an early introduction of a thorough-going metric system into America); "what is the sum of $\frac{2}{3}$, $\frac{3}{5}$, $\frac{5}{7}$ and $\frac{7}{9}$? The rate of taxation of a city is $1\frac{1}{2}$%. What tax must a citizen pay whose property is assessed at \$4500?"

There are no answers supplied to any of the questions (except in two or three instances) throughout the book; it is, as we have said, a guide to the teacher; the young pupils for whose instruction it is intended are not yet *students*.

Of course, the American coinage, with which the questions deal, would require alterations to render the book suitable to English use; but there is no doubt that the author has very skilfully conceived the nature of an effective process of teaching young children, and we think that the exact following of his course and method would prove to be productive of excellent results.

OUR BOOK SHELF.

The Trees, Shrubs and Woody Climbers of the Bombay Presidency. By W. A. Talbot, F.L.S. Second Edition. Pp. xxv + 385. (Bombay, 1902.)

WHEN Sir Joseph Hooker's "Flora of British India," now completed, was undertaken, one of its main objects was stated to be to furnish a basis on which local floras could be constructed. India is so vast, its climatic features are so varied, the economic requirements of its several provinces so diverse, that a general work like that of Hooker needs to be supplemented by local floras in which the special requirements of particular districts can be fulfilled. There is gratifying evidence to show that these requirements are in course of being supplied. There is, for instance, the "Forest Flora of the North-West," by Sir Dietrich Brandis; Sir George King is engaged on the "Flora of the Malay Peninsula"; the "Flora of Ceylon" was completed by the late Dr. Trimen; and General Collett's book on the plants of the Simla district has just been published. We might cite many similar works from the pens of Prain, Clarke, Duthie, Watt, Kurz and others, but enough has been said to show that Sir Joseph Hooker's aim is in process of fulfilment, and that the splendid botanical heritage handed down to us by Roxburgh, Wallich, Wight, Griffith and others is in no danger of being squandered, but is being utilised and extended by the labours of the present race of botanists. When we bring to mind the fact that instruction in botany, at any rate in systematic botany, no longer forms part of the curriculum in the education of medical students, and that complaints have been made as to the lack of interest felt in the subject by the majority of forest officers, this evidence of substantial progress may at least be adduced as a set-off.

The work before us is another instance of the same kind. In form it is modelled upon Hooker's "Flora," in substance it contains a "fairly correct" list of the indigenous ligneous vegetation of the Presidency, together with additional matter relating to distribution, bark, woods and economic products, along with a large number of vernacular names.

The book is in its second edition, and hopes are thrown out that the "next edition" will expand into a handy Bombay forest flora. Actual use in the field or forest, or even in the herbarium, is needed to enable the reviewer to form a complete estimate of the value of such a work. It must suffice to say that the author's method is good, and that it bears the impress of care and accuracy in its production.

La Géologie générale. By Stanislas Meunier, Professeur de Géologie au Muséum d'Histoire Naturelle. Pp. vi + 336; 42 woodcuts. (Paris: Alcan, 1903.) Price 6 francs.

IN this volume, Prof. Stanislas Meunier undertakes, for the International Scientific Library, a presentation of those branches of geological science not already dealt with in his "Experimental Geology" and his "Comparative Geology," published in the same series.

In the introduction to the book, the author defines the ideas which have successively dominated geological theory during the nineteenth century as (1) the cataclysmal views of Cuvier; (2) the uniformitarianism of Lyell; (3) the "actualism" of Constant Prévost; and (4) the "activism," which he regards as the distinctive feature of modern geological thought.

In conformity with this latter point of view, the author then proceeds to discuss the three great causes of change in the earth's crust, namely, the central heat of the globe, the effects of pressure and the influence of the sun's heat. Pursuing this deductive, rather than inductive, mode of treating his subject, the questions next considered are the flexible earth's crust, volcanoes, the action of subterranean and superficial waters, the sea, glaciers, the atmosphere, and vital action. In dealing with each of these subjects, the originality of the author is everywhere manifest, the examples and illustrations chosen being, for the most part, new, and often of a very striking character.

In the second part of the work, which is entitled "Comparative Physiology of Successive Geological Epochs," the effect of the several agencies enumerated

during past geological periods is traced, and here we have to notice the same freedom from the stereotyped methods and matter of text-books of geology which we have remarked upon in the earlier portions of the work. Subjects like the cause of the formation of concretionary structures in rocks are treated at considerable length and with much skill, though, it must be confessed, with considerable inequality. On the other hand, many important questions which do not happen to have been made the subject of special research by the author are treated in a superficial manner or altogether passed over, there being little obvious connection between the space devoted to various divisions of the subject and their relative importance.

As a work designed to attract the attention of a general reader and to stimulate the thought of more advanced students, the work is excellent. But it is rather as a supplement to other books on the subject than as an independent treatise that its value is most apparent, for it is wanting in many of those features which are necessary in a work which is designed to give a presentation of the present state of geological knowledge. It is unfortunate that the book is not provided with an index.

The Student's Handbook to the University and Colleges of Cambridge. First Edition, Corrected to June 30, 1902. Pp. 468. (Cambridge: University Press, 1902.) Price 3*s.* net.

IN this volume, the editor has brought together in a concise form all the more interesting facts and methods of procedure which every student should desire to know as he proceeds to the University of Cambridge as an undergraduate. There are twenty-three chapters in all, and each is devoted to special items.

After a short and condensed account of the history of each college, with a list of the officials at present in residence, the reader is made acquainted with the conditions of admission to any particular college, the period of residence, discipline, and an excellent survey of the average expenditure necessary.

The next four chapters are devoted to the details of the conditions and value of the entrance scholarships, exhibitions and sizarships, and the various University and college scholarships and prizes, concluding with a general account of the objects for which the several institutions of the University are utilised.

The handbook then gives useful information on the work of teaching as divided between the University and the different colleges, and then proceeds to bring together all the necessary information for those who are about to qualify for the previous, ordinary B.A. degree, and honours examinations.

After two brief chapters on advanced study and research and examinations for medical students, detailed information is given on the subjects of the B.A. and superior degrees, diplomas and fellowships, followed by useful chapters for candidates for Holy Orders, for the Civil Service and Army, and for teachers.

The final chapters show the facilities for the education of women in the University, an account of the more important outside examinations conducted by the University, concluding with a description of the object and work of the scholastic agency and the Appointments Board.

Bacteriological Technique and Special Bacteriology. By Thomas Bowhill, F.R.C.V.S. Second Edition. Pp. xvi + 324. (Edinburgh: Oliver and Boyd, 1902.) Price 21*s.* net.

As might have been anticipated, a second edition of Prof. Bowhill's book has been rendered necessary by the rapid sale of the first edition.

The book is divided into seven parts, as follows:—Part i., principles of bacteriological technique; part ii., the preparation of nutrient media; part iii., special bacteriology; part iv., the Hyphomycetes; part v., the Blastomycetes; part vi., the Protozoa; part vii., diseases due to undetermined infective agents. The illustrations number 136 and they are all of the highest class. In particular, the photomicrographs, executed by the author and reproduced by the collotype process, are admirable.

The author has the advantage of being, not only a bacteriologist of high repute, but also an acknowledged veterinary expert. It is not surprising, therefore, to find that the diseases of microbial origin, which affect the lower animals as well as human beings, are dealt with in a conspicuously able fashion.

The descriptions of swine fever, swine plague, swine erysipelas, pleuro-pneumonia, contagiosa bovis, broncho-pneumonia bovis, grouse disease, diphtheria and glanders are excellent.

The author has added much new matter to the text, and the book is thoroughly up to date.

Part vii., dealing with diseases due to infective agents of undetermined character, is a specially useful article. As regards rinderpest, the author gives a graphic account of the methods adopted during the recent outbreak of the disease in South Africa. The methods were as follows:—(1) Koch's original bile method; (2) glycerinated bile method (Edington); (3) serum method of Turner and Kolle; (4) defibrinated blood method. Lucid descriptions are given of the best way of preparing the serum, bile and defibrinated blood.

The methods of examining air, water, soil, unsound meat and ice cream are insufficiently discussed, and the bacteriological examination of sewage is apparently not considered at all.

In conclusion, it may be said that no student in veterinary, medical and sanitary science should be without a copy of this excellent manual. That the book will enhance the enviable reputation of the author is beyond question.

Practical Electricity. By J. Hope Belcher. Pp. xi + 165. (London: Allman and Son, Ltd., 1902.) Price 2*s.* 6*d.*

THIS book is intended to be an elementary manual for a laboratory course in practical electricity. It contains instructions for carrying out a number of experiments designed to illustrate the principles of magnetism and electricity. The course is largely modelled on that given by Prof. Ayrton at the City and Guilds Institute. The experiments are well chosen, and the description and instructions seem to us adequate. The student is shown how to tabulate and set out his results, and some useful hints are given to teachers of elementary science as to the conduct of a laboratory class. We notice in one of the experiments the old fallacy of "proving" Ohm's law by a method in which P.D.'s are measured with an electromagnetic voltmeter; it is remarkable how hard this fallacy is to kill. Apart from this and a few minor blemishes, Mr. Belcher's book is a useful little manual.

M. S.

Acht Vorträge über physikalische Chemie. Von J. H. van 't Hoff. Pp. 81. (Braunschweig: Vieweg und Sohn, 1902.) Price 2 Mk. 50 Pf.

PROF. VAN 'T HOFF delivered these lectures in June, 1901, on the invitation of the University of Chicago. As they were intended for a mixed audience, they have a more or less popular character, but in places they would be difficult for anyone lacking special knowledge to follow, without the personal influence of the lecturer. Two lectures each are devoted to the influence exerted by physical chemistry on pure chemistry, technical chemistry, physiology and geology. The treatment is necessarily meagre, but many interesting subjects are touched upon, and to students of science these lectures must prove stimulating and suggestive to a degree.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Secular Changes of Climate.

FOR some time past it has been generally believed that the climate of Central Asia was once less arid than at present, but we now know, as Dr. Sven Hedin explained to the Royal Geographical Society on December 8 (p. 134), that important changes have taken place since the Christian era began. He found in the Lob Nor region forests with the trees long dead, traces of a road, ruined villages, coins, manuscripts and other relics which proved the northern shore of the old salt lake (now dry) to have been cultivated and occupied, down to about sixteen centuries ago, by a fairly civilised people. This, I think, implies a rainfall, less inappreciable than the present one, during the earlier centuries of that era, and the change, as he found dead forests, cannot be attributed (as in parts of southern Europe and Syria) to reckless destruction by the hand of man. But, besides this, Sir Norman and Dr. W. J. S. Lockyer have recently proved (in a communication to the Royal Society) a very remarkable correspondence to exist between the distribution of the periodic rains in India, Mauritius and elsewhere and the amount of solar activity, and they have, within the last few days, drawn the attention of the same Society to the fact that zones of abnormally high and low mean barometric pressure exist on opposite sides of the earth and oscillate from the one position to the other in accordance with the periodic small variations of solar activity. Dr. Sven Hedin's discovery apparently indicates a change secular rather than periodic, but may not both operate independently, as in the case of changes due to variations of eccentricity in the earth's orbit and to precession of the axis of rotation? The authors of those papers admit the existence of disturbing causes, some of which may be local, but not necessarily all. Is it, then, possible that these discoveries may afford a clue to the solution of two great geological puzzles—the abnormal temperatures of the Pleistocene and of early Tertiary times? In regard to the former, many now believe that the climate of North Central Europe when the loess was deposited more nearly resembled that of the Caspian steppes, and all maintain that in the Glacial epoch the mean temperature of the whole continent was much below what it is now. How much this was, at the time of greatest cold, is not easily estimated, but a few years ago I attempted a rough approximation. This will be found in a volume of the Contemporary Science Series called "Ice Work" (part iii. chap. i.), and the results (for Europe) are as follows:—Supposing the British Isles to be at their present level (in order to avoid the controversy as to the origin of Boulder-clays and Glacial gravels), the mean temperature of these islands at the present Ordnance Datum would have to be lowered by about 20° F. The same would probably hold good of Scandinavia—at any rate, that would suffice to make either country much more closely resemble a corresponding part of Greenland. In the more central parts of Europe, the problem is rather easier, for here we are undoubtedly dealing with "land-ice." A fall of 18° in the mean temperature would suffice for the Alps; perhaps rather less, 15 or 16°, for the Pyrenees, the Sierras Guadarrama and Nevada, possibly also for the breccia-producing age on the Rock of Gibraltar. A reduction of 18° at most, and more probably about 16° or 15°, would bring back small glaciers to Auvergne, the Schwarzwald, Vosges, Apennines, Corsican mountains, the Caucasus and even the Atlas. I may add that a reduction of 15° appears sufficient to form a great ice-sheet in North America, and that in the southern hemisphere and at Mount Kenya in Africa distinctly smaller change suffices. All these estimates assume the present levels maintained; they may be corrected at the rate of 1° for each 300 feet of elevation or depression. But geologists too often forget that the anomaly of early Tertiary heat is not less difficult to explain than that of Pleistocene cold, for in later Eocene ages the mean temperature of southern England can hardly have been less than 20° above that which it now enjoys. The explanations which have been offered for the Glacial epoch —a different arrangement of sea and land, variations in eccentricity, precessional movements (none of which, in my opinion, are more than partially successful)—cannot be applied to the latter case, so that we seem compelled to seek for some other cause. Variations in solar heat have been already suggested, but hitherto this hypothesis has seemed too much a *Deus ex machinâ*. But as Dr. Sven Hedin's discoveries show that important alterations in climate have been in progress during the last fifteen or sixteen centuries, and Sir Norman Lockyer's researches indicate that comparatively small changes in solar activity produce rather important meteorological effects upon the earth, geologists qualified for the investigation may find it not unprofitable to follow up the clue. T. G. BONNEY.

The Government Grant for Scientific Research.

NOW that the annual advertisement of the Government grant is once more appearing, I should like to call attention to the long interval that elapses between the date appointed for the reception of applications for, and that of making known the distribution of, the grants. The former is fixed for January 31, the latter is some time in May, a period of more than three months. This seems to me to detract somewhat from the value of the grants, for, in certain instances at least, the conditions may have quite altered in so long a time and the possibility of making a particular research have passed away.

King's College, December 8. R. T. HEWLETT.

The Unconscious Mind.

IN a recent review (November 20) of my book on the "Force of Mind," "W. McD." remarks, "The book is vitiated throughout by the insistence upon the part supposed to be played by the unconscious mind."

But a closer attention to the argument would have revealed the fact that, while no stickler for a word and still less an advocate for two minds, the author is compelled to give some name for mental processes unaccompanied by consciousness.

The position of the man who denies any mental processes at all, as distinguished from mechanical, is logical; but the position of the man who distinguishes mental processes (that is, processes which a machine cannot conduct apart from mind) from mechanical, and at the same time will only recognise as mental those accompanied by consciousness, is illogical. The self-same mental process at one time may be conducted in consciousness and at another outside it, and he is therefore on the horns of this painful dilemma. He must either at one time call the process mental and at the other mechanical or "nervous," or he must extend the word "consciousness" so as to include the unconscious. To a psychologist, the consequences of such a theory are deplorable and are described in scathing terms by Prof. James [1] when he depicts the present state of this conservative science; while with a medical man it compels him logically to regard cases of neuromimesis as malingering or fraud because he sees the disease has mental characteristics, and yet cannot, according to the old psychological shibboleth, recognise as mind the unconscious psychic agent. I may say in conclusion that the need for this extension of mind has been felt by none more keenly than by the very psychologists who have refused it. The student of this subject has only to turn to Prof. C. T. Ladd's "Philosophy of Mind," p. 395, and compare it with p. 393; or to Prof. Sully's "Illusions," pp. 266 and 335, to see the existence of unconscious mental actions both asserted and denied in the same book.

These passages and others will all be found in my work [2] on the subject. A. T. SCHOFIELD.

6 Harley Street, W., December 15.

DR. SCHOFIELD objects to my strictures on his extensive application of "the unconscious" as an explanatory principle that solves (for him) all problems of the relations of body and spirit. And he persists in confusing the question of the validity of "the unconscious" with the question of the propriety of so extending the use of the terms "mind" and "mental" as to make them applicable to brain activities that do not involve affections of consciousness. This extended use of the words I myself, following Dr. Bastian, have urged and adopted, but to do this is not to commit oneself to the hypothesis of "the unconscious mind." Dr. Schofield's use of this phrase implies the assumption of a factor in mental life that is neither neural process nor conscious process, but an utterly unknown, unknowable and mysterious third agent, more or less intervening between the two

[1] Prof. W. James, "Psychology," p. 468.

[2] Dr. Schofield, "The Unconscious Mind," 2nd edition. (Hodder and Stoughton.)

known processes. This I hold to be a radically vicious hypothesis, not merely because it is unverifiable (for, in spite of the dictum of J. S. Mill, that appears to be an insufficient ground for condemnation), but (1) because it invokes an agency of an absolutely unknown order, (2) because it is not necessary and does not help us to give a consistent description of the facts, (3) chiefly because it serves merely as a cloak disguising our ignorance and must tend to make those who adopt it content to remain ignorant. Dr. Schofield's position seems to be based solely on the following argument:—

The human organism exhibits activities that cannot be shown to be accompanied by corresponding states or processes of consciousness, but which nevertheless display so great a complexity and nicety of adjustment of means to ends that we cannot suppose them to be carried out by the agency of neural processes only; therefore we must assume an agent that plays a part similar to that which we assign to consciousness, but differing from it merely in not being consciousness. But when many of our leading thinkers accept the view so clearly enunciated by Huxley in his essay on "Animal Automatism," the view, namely, that all human activities are carried out by the agency of neural processes without the causal intervention of any other factor, consciousness being an epiphenomenon merely, why should Dr. Schofield believe himself competent to draw a line at any particular degree of complexity of behaviour, saying "So much can the unaided neural processes accomplish, but no more."

W. McD.

THE UNIVERSITY OF LIVERPOOL.

IN 1879, Dr. Lightfoot, speaking at a prize-giving in Liverpool, described as seen in a dream its future University College. The speech had no small influence in securing the foundation of the College, and twenty-three years have done much to realise the dream.

The progress of University College has been most striking; it started in 1881 with seven professorships and three lectureships. Now there are twenty-one professorships each endowed with the sum of 10,000*l.* and one temporarily endowed. The total number of professors, lecturers and assistants is seventy-two, and the value of the endowment about 226,000*l.*

Practically all of this has been given by citizens of Liverpool, much in single sums of 10,000*l.*, for the founders, inspired by Mr. Rathbone, were wise men, and realised that they were providing for a large need and must do it on a large scale.

The value of the College site and buildings already erected is about 280,000*l.*, while 50,000*l.* from the fund recently raised is to be spent immediately in further buildings. For scholarships, prizes, the maintenance of laboratories and of the Day Training College, about 60,000*l.* has been invested; a capital sum of more than 600,000*l.*, contributed in twenty-three years by Liverpool benefactors for the advancement of learning and for the education of their townsfolk.

Besides this, large sums are given voluntarily each year for annual expenditure. The city shows its interest in a practical manner by the grant it makes towards certain of the technical classes, while the fees received from students last year reached 13,000*l.* These results, though they may seem small compared with some of those achieved through individual generosity in America, are splendid. The Bishop's dream is nearly realised.

Now the men who have done this come forward and say that it is necessary for the future success of their work that the union which exists between the three colleges of the Victoria University should be dissolved, and that Liverpool should have its own University. Can anyone gainsay their right to speak or urge that they are not the best judges of their case?

They speak with no uncertain voice. The Education Bill transfers to the City Council the control of education in the city, and the Council is of opinion that a University of Liverpool is necessary as the keystone of the arch it intends to build; it has already received power to raise a rate for university education if a Charter is granted to University College, and it intends to do it. It is inconceivable that that Charter should be refused, that the Government, which has indicated its wise desire to leave freedom wherever possible for the development of education according to local needs, should refuse the request of one of the greatest of the local authorities of the country, the Corporation of Liverpool, to complete its work by establishing a "great university for a great city." These were the words used by Mr. R. B. Haldane at a city dinner in Liverpool some four years since; it was clear from their reception then that the ideal he put forward appealed strongly to the representative gathering which he addressed, and in the joint petition of the City and University College for a Charter which is now before the Privy Council we have the outcome of his words.

The case is one which carries conviction as it is read. The grant, it is urged, would greatly stimulate the development and increase the influence of University College and other institutions for the promotion of higher education in the city; it would bring higher education into closer connection with the professional and commercial life of the city; it would provide a true university education for many who cannot leave home to obtain it—the promoters urge with success the distinction between education in a university college, a part of a federal university, and that in a university—it would stimulate research by multiplying in the proper places the centres at which this can be carried on, and, having regard to the inadequate provision of the higher forms of education in England relatively to foreign nations, would be for the benefit of the nation as a whole.

Each of these claims is substantiated by solid facts.

The success of the movement will mean the dissolution of the Victoria University in its present form.

To this, Owens College, the predominant partner in the federal University, has given a ready consent; the two great cities of south-west Lancashire are at one in the belief that each may well be the centre of an independent university, and the case for Owens College is in many ways stronger than that for Liverpool. Yorkshire College, on the other hand, wishes to retain the present system. The financial position of Yorkshire College is much weaker than that of her sister colleges; Mr. Lupton at Leeds in January last said, when speaking of the number of its students, "It will compare favourably and creditably with the other two colleges of the University, but in its material assets it is ludicrously wanting. In the capital of the College, the assets are between 250,000*l.* and 300,000*l.*, but the money has been spent on buildings, apparatus, &c. Of invested capital, we have not quite 39,000*l.*, the income of which goes to the annual expenditure of the College."

At present, then, Yorkshire College is less fitted than the others to become a university, hence in part its dislike at being left alone. But Yorkshiremen are quite able, as was stated by the Principal of the College and the Bishop of Ripon at the same meeting, to create a university of their own if the need for it arises, and it will be found in Leeds no less than in Liverpool that a great university is a great power for good and for advancement.

To Liverpool and Manchester, the failure of the petition would be disastrous; it would curb enthusiasm, it would check the flow of benefactions for education, it would discourage men whose whole heart is in the great work they have set themselves to do, to build in each of these two cities a university which they feel is needed for the highest training of men and women in whose hands the future rests; it would compel two responsible bodies who have each decided that it can best perform its allotted duties separately to endeavour to struggle on in a union which they feel is hopeless.

All this is clear to anyone reading the case presented, so clear that of the issue there can surely be no doubt.

THE MINNESOTA SEASIDE STATION.

AMONG newer American establishments for the study of marine biology, the Minnesota Seaside Station has awakened considerable interest. It is upon British soil, being situated about sixty miles north-west of Victoria, British Columbia, just at the entrance of the Straits of Fuca. The site was chosen after a careful reconnaissance of the Pacific coast, both Canadian and American, and presents some remarkable advantages. So far as accessibility is concerned, it may be reached from Seattle, Port Townsend or Victoria, and commands, not only the outer waters of the ocean, but the region of Puget Sound as well.

FIG. 1.—Buildings of Minnesota Seaside Station as seen across Station Cove. The large laboratory building is not shown, but stands immediately to the right of the smaller building. The buildings face nearly south.

The physiographic features of the shore in the vicinity of Port Renfrew, Vancouver Island, the nearest harbour to the Station, are extraordinarily favourable for the development of its special and characteristic work. The country rock is a tilted slate, cut by dykes of diabase and overlaid by millstone grit and sandstone. The bold promontory, just north of the Station, is of sandstone covered with glacial drift. The very broad shelving shore of sandstone is dotted with a great number of pot holes, worn by glacial boulders and ironstone concretions from the country rock. These pot holes vary in size and depth from little shallow saucers a few inches across to huge wells and cisterns many yards in diameter and often twenty feet or more in depth. Hundreds of such pools between tide marks serve as natural aquaria. Each has its characteristic distribution of plants and animals. For this reason, the Station shore is astonishingly rich in types of oceanic fauna and flora. Within a couple of miles, the formations change, and no other place upon the entire Alaskan, British Columbian or Californian coast is known to be so favourable for naturalistic study and research as that where the Minnesota Seaside Station has been built.

The thing of most importance about a seaside station is the sea. Minnesota, occupying a mid-continental position, might send its students with equal ease to the Atlantic or to the Pacific. It seemed, however, that a rallying point upon the Pacific would be the more inspiring. The eastern shore is already somewhat hackneyed and over civilised, so that the distractions of village life, golf, yachting and society may, in some circumstances, interfere with the free and genuine activities of a station. It is undeniable that, when a laboratory by the sea has acquired the appurtenances and refinements of a highly organised institution, something is lost on the side of Nature to counterbalance the gain in comfort and conventionality. The Minnesota Seaside Station, two thousand miles distant from the laboratories of the University of Minneapolis, behind the great plains and mountain ranges, sixty miles from any considerable settlement, free from the influence of morning newspapers, daily mails and inquiring tourists, has for its paramount source of interest and principal spring of enthusiasm the sea, and the sea alone.

From its site, three miles south of the harbour of Port Renfrew, visited four times a month by a little coasting steamer belonging to the Pacific Navigation Co., the Seaside Station looks out directly towards Cape Flattery. To the right roll the swells of the open Pacific. To the left, across the blue straits, rise, peak upon peak, the Olympics with their glistening glaciers, untrodden summits and eternal snows. There are few more beautiful spots in northern latitudes. One feels the magic of the mountains, the forest and the sea, and not to be a naturalist in such an environment is scarcely possible.

FIG. 2 Group of students holding an extended specimen of the Giant Kelp, *Nereocystis priapus*. The holdfast is seen hanging down on the right and the leaves are held upon the left.

During its first season, there were twenty-nine in attendance at the Station. In 1902, the number rose to

thirty-eight. Most of the party met at Minneapolis and journeyed to the coast in chartered cars which were cut off for several days in the mountains both going and returning. This enabled those who wished to climb some of the peaks in the vicinity of Banff, Laggan and Glacier. The whole region along the Canadian Pacific Railway from Banff to Mission abounds in problems for alpinists, and there is no better climbing in Europe or North America than that near Laggan, where Mounts Temple, Victoria, Hector, Hungabee and Lefroy, among the rest, are a perpetual challenge to the venturesome.

At the Minnesota Seaside Station, three buildings have been erected. One, a large log boarding house some thirty by sixty feet upon the ground and two storeys in height, serves as a camp. A smaller one-storey log house is used as a laboratory for zoology, and a two-storey frame building, twenty-four by forty feet in dimensions, is occupied by elementary and advanced students of botany. Lecture courses last year were conducted for the most part out of doors—either in the forest or upon the rocks by the sea. Indoor talks in connection with microscopic study of fresh material or around the fireplace in the large living room after dinner were also features of the work.

Several papers, both of a scientific and popular nature, and based upon observations or research at the Minnesota Seaside Station, have already been published. Some of these have appeared in "Minnesota Botanical Studies" and others in "Postelsia," the year-book of the Station, the volume of which for 1901 has recently come from the press.

Many useful phases of marine biological work have not yet been, and perhaps never will be, developed at Port Renfrew. There is an absence of dredging apparatus. No pumps, conduits or artificial aquaria have been installed, nor are the buildings supplied with electricity or gas. A serviceable steam launch is still one of the dreams of the future. Unlike most other marine stations, the one on the Straits of Fuca has never received any gratuities whatever from Government, institution, society or individual, but has been built and modestly equipped entirely through the cooperation of those who have enrolled themselves among its members. It is, in fact, organised somewhat like a club, and while unable to compete with the older stations in expenditure, nevertheless derives a certain advantage from its community of interest and independence.

For the use of the illustrations which accompany this article, we are indebted to the *Popular Science Monthly*.

FIG. 3.—Kelp-covered rock at low tide showing specimens of Alaria, Egregia and Halosaccion in characteristic attitudes. *Phyllospadix scouleri* appears in the foreground.

MR. CARNEGIE'S ST. ANDREWS ADDRESS.[1]

MR. CARNEGIE'S rectorial address at St. Andrews is an interesting study in the psychology of the typical business man of modern times, as well as a memoir on the conditions of great business, which people must read for the sake of the shrewd and acute remarks themselves, such as no statesman or economic student can afford to overlook. The address is written exclusively from the point of view of a great industrial chief who has availed himself to the full of the conditions of business in the most favoured and wealthy community which the world has yet seen—that of the United States. He has observed and seized the great opportunity for the concentration and development of industry on a large scale which the United States has afforded. A large area of complete internal free trade, and an active, vigorous and rapidly growing population throughout this area, have given the United States manufacturer for many years an unrivalled opportunity for colossal arrangements, involving the cheapening of cost by means of subdivision of labour and the institution of mechanical and automatic processes wherever hand labour could be superseded. This opportunity, properly used, has been the occasion of Mr. Carnegie's gigantic fortune, and it is accordingly natural that he should speak of all business as conforming to this type, so that a community like the United States supplies the model for great manufacturing business in future. The cheapness of production once established, it is assumed, will enable the United States to be the most successful competitors internationally, and Britain accordingly will take a second place in future, if not a third place, with Germany second. Naturally also, Mr. Carnegie regards the protectionist policy of the United States as having contributed to this result and given the United States manufacturer the monopoly of his large home market. Nor is it surprising to find the ordinary American idea about the economic effect of military armaments put forward by Mr. Carnegie as explaining the backward state of Europe compared with the United States. The ideas come from his environment and history, and the result of their combination with Mr. Carnegie's own shrewd observations is the present most instructive address.

The interest, however, is mainly psychological. Economically, there is nothing really new and true. Adam Smith explained long ago the economic gain of the subdivision of labour, the condition of manufacturing on a large scale, while the practical value of manufacturing on a large scale and for the largest possible market was exemplified first of all, not by the American, but by the Lancashire manufacturer, who had the home market of

1 A rectorial address delivered to the students in the University of St. Andrews, October 22, by Andrew Carnegie. (T. and A. Constable, 1902.)

the British Empire at his command as well as the general market of the less civilised nations of the earth. Where the United States has gone ahead has been in the special business of iron and steel, a development required by the more special conditions of industry in the United States, and not in every business requiring large markets. *Pace* Mr. Carnegie, also, it does not appear that the protectionist policy of the United States has favoured the development of great manufacturing. In iron and steel especially, the advance was favoured by naturally high prices attending the great demand for iron and steel, which was always producing a shortage in the old countries of Europe, especially Great Britain, such as we now witness in the United States itself. This recurring shortage, apart from the United States tariff, must infallibly have developed naturally the iron and steel industry of the United States, though Mr. Carnegie and others might have realised smaller fortunes than they have done in the process. As to Europe being overweighted in any way by military armaments, there is an obvious want of connection between the effect and the alleged cause. Extravagant expenditure is, of course, one reason why one community or individual should accumulate wealth at a lower rate than another community or individual, but extravagant expenditure on military objects has precisely the same effect, and no other, as any other kind of extravagance. Overbuilding, excessive outlay on dress or carriages, outlay on churches or theatres, are, or may be, forms of expenditure in which nations or individuals may indulge to their hurt as well as in armies and navies. Nor can the American community throw stones at any other community in this matter, as extravagance is one of the American's special vices, and there is one conspicuous case of this extravagance in the remarkable pension list which has grown up since the Civil War, and affects them economically much as a great debt or great expenditure on army and navy would affect them. Besides, when analysed, however great the outlay may be, the maintenance of armies and navies does not add to the cost of production in other industries in any country. The expense of these "luxuries," let us call them, is a deduction from the earnings of the community, so that there is, *pro tanto*, less to spend on other things; but the cost of producing these other things is not concerned.

While making these observations on Mr. Carnegie's theories, we cannot but agree with his view that the primacy of Great Britain as an economic unit is passing to the United States. The economic force of the United States is obviously the greatest single force of that kind; and the preponderance of the United States is increasing. This is no new idea. Mr. Gladstone and many others long ago pointed out how modern industrial forces were tending. People should weigh well, however, what Mr. Carnegie has to say in his own department as to the approaching exhaustion of the iron ores of Great Britain, a matter of common knowledge to those interested. Great industrial changes must follow this impending change. More interesting and surprising even is Mr. Carnegie's anticipation as to the exhaustion of the United States supplies themselves. "Even the United States," he says, "has a proved supply of first class ore only for sixty to seventy years, and a reserve of inferior grades which may keep her supplied for thirty years longer, say for a century in all, unless the rate of consumption be greatly increased. The enormous extent of territory in the republic over which ore can hopefully be looked for encourages the belief that new deposits are sure to be found." Germany, it is added, has the most enduring supply, although its ore is not nearly so rich as the American. All this points to great economic changes even more far reaching than what is implied by the exhaustion of iron ore in Great Britain only.

With many other observations, there must also be agreement, especially as to the importance of home markets, the diminishing importance of foreign trade and the like. There is, in truth, no distinction in essence between home and foreign markets. The proper distinction is between near, less near and distant markets which are all in their nature the same, the availability and accessibility in each case varying with every variety of goods and every variation in the conditions of transportation. Other things being equal, there is, of course, more exchange between near than between distant markets, and there are many goods and services where the exchanges are necessarily local.

The one weak point in the address is really what is said about the effect of European armaments, upon which comment has already been made. It may be admitted that, so far as there is insecurity and fear of invasion, Europe is politically less advantageously placed than the United States, and European business is, *pro tanto*, checked. But in itself, military expenditure is no worse than any other expenditure, and so far Europe is not handicapped in the race. We should like to throw out also for the consideration of Mr. Carnegie and other Americans whether they are not living in a fool's paradise so far as their supposed safety from invasion is concerned. If the United States fleet were to be defeated by a European Power, say by Germany, and circumstances were otherwise favourable, the territory of the States would not be safe from invasion. Descents upon the coast such as England was able to make in the War of Independence and in the war of 1812 might be repeated, and even a more serious invasion attempted. The American boast of their freedom from European militarism is one which it is not quite wise or safe to make.

R. G.

THE JUBILEE OF LORD LISTER.

On December 9, 1852, just fifty years ago, Joseph, now Lord, Lister passed his examination and was admitted a Fellow of the Royal College of Surgeons, thereby becoming a member of the medical profession. The jubilee of such an event abroad would have been made the occasion of a congratulatory address and of the compilation of a notable "Festschrift" to the honour of the great master of antiseptic surgery. Here we do things differently, and it has been reserved for the *British Medical Journal* to issue a Lister Jubilee number, in which eminent men of various nationalities give their appreciation of Lister's life-work.

Von Bergmann, of Berlin, contributes some remarks upon the use of iodoform gauze in operations upon the cavities of the body; Lucas-Championnière, of Paris, writes on Listerian methods of the present and of the future; and Oscar Bloch, of Copenhagen, upon the antiseptic system in Denmark; while von Mikulicz-Radecki, of Breslau, gives a contribution upon the treatment of fractured patella. Among the British contributors, Ogston, of Aberdeen, and Hector Cameron, of Glasgow, discuss the influence of Listerism upon military surgery and upon the evolution of modern surgery respectively, Watson Cheyne, of London, discusses Listerism and the development of operative surgery, while Annandale, of Edinburgh, writes pleasantly of early days, and Chiene, also of the Scotch capital, gives an account of the Edinburgh Royal Infirmary from 1869 to 1877—that is to say, during the time Lister held the chair of clinical surgery there. It is a notable number devoted to a notable man.

Although it is as the founder of antiseptic surgery that Lister's name will descend to posterity, his other achievements must not be forgotten. Into surgery he introduced many valuable methods of operative procedure and also the use of the catgut ligature, and his contributions to the

pathology of inflammation, the nature and mechanism of blood coagulation and the bacteriology of fermentation would alone entitle him to a place among the "Scientific Worthies." A characteristic trait of a great personality must have struck all those who had the privilege of working under Lister; this was his intense regard for the welfare of his patients. The writer well remembers Lord Lister's distress at some mishap which befell a patient, unforeseen at the time, but which, in the light of after events, might have been preventable.

Lord Lister's great experience has been called into requisition at least twice in recent years to aid the deliberations of those in whose hands the health of His Majesty the King has been entrusted, once when he was Prince of Wales and secondly in his recent severe illness. Lastly, as chairman of the King's Hospital Fund, he still continues his benefits to humanity. His various contributions to science and the honours bestowed upon him have already been detailed in NATURE, but it may be mentioned that this year he has been the recipient of the Copley medal of the Royal Society and of the Order of Merit. R. T. HEWLETT.

NOTES.

THE First Lord of the Treasury has appointed a committee to inquire and report as to the administration by the Meteorological Council of the existing Parliamentary grant, and as to whether any changes in its apportionment are desirable in the interests of meteorological science, and to make any further recommendations which may occur to them, with a view to increasing the utility of that grant. The committee will consist of:—the Right Hon. Sir Herbert E. Maxwell, Bart., M.P., (chairman), Mr. J. Dewar, M.P., Sir W. de W. Abney, K.C.B., F.R.S., Sir F. Hopwood, K C.B., Board of Trade, Sir T. H. Elliott, K C.B., Board of Agriculture, Dr. R. T. Glazebrook, F.R.S., Mr. T. L. Heath, Treasury, and Dr. J. Larmor, F.R.S. Mr. G. L. Barstow, of the Treasury, will act as secretary to the committee.

ANNOUNCEMENT has now been made of the Nobel prize awards this year. The awards include the following for science:—Medicine, Major Ronald Ross, School of Tropical Medicine, Liverpool; chemistry, Prof. Emil Fischer, Berlin; physics, divided between Prof. Lorenz, Leyden, and Prof. Zeeman, Amsterdam.

DR. BORDAS, assistant-director of the Paris Municipal Laboratory, has been awarded the Lacaze prize for his investigations in connection with typhoid fever. The prize is worth 400*l*.

DR. T. K. ROSE has been appointed chemist and assayer in the Royal Mint, in succession to the late Sir W. C. Roberts-Austen, K.C.B., F.R.S.

DR. SVEN HEDIN delivered an address before the Royal Scottish Geographical Society at Edinburgh on Tuesday. Sir John Murray, who presided, announced that the council had awarded Dr. Hedin the Livingstone memorial gold medal for the distinguished services which he had rendered to science by his explorations in Central Asia.

WE regret to see in the *Athenaeum* the announcement of the death of Prof. J. Wislicenus, professor of chemistry at Leipzig University.

COLONEL SIR T. H. HOLDICH has been appointed Knight Commander of the Order of St. Michael and St. George for services in connection with the Chile-Argentine Boundary Tribunal.

ACCORDING to the Paris correspondent of the *Times*, Prof. Lacroix, the head of the French Scientific Mission at Martinique, has reported that owing to the undermining of the point of the cone formed in the crater of Mont Pelée, masses of material have rolled down in the direction of White River, completely choking it. The ashes which filled the lower valley at a distance of six kilometres from the crater had still a temperature of more than 100° C. a week after they had been projected from the volcano.

WE regret to have to announce the death of Dr. Antonio d'Achiardi, of Pisa, in his sixty-fourth year. Dr. d'Achiardi was born and educated at Pisa, and had occupied the chair of mineralogy and geology in the University there since the year 1876. He was the author of treatises on both mineralogy and petrology, and published numerous memoirs, many of them relative to the mineralogy of Tuscany. Prof. d'Achiardi was an honorary member of the Mineralogical Society of this country.

THE following announcements of deaths, from yesterday's *Times*, will be read with regret by many men of science:—Prof. Millardet, professor of botany, first at Nancy and afterwards at Bordeaux, where his researches checked the ravages of the phylloxera.—Privy Councillor von Kupffer, professor of anatomy at the University of Munich.—Major Walter Reed, one of the foremost bacteriologists and pathologists of the United States. During the Spanish war he was a member of the board to investigate typhoid fever in the army. Later, he made several trips to Cuba and was on duty in Havana studying the diseases of the island as a member of the board to investigate the causes of yellow fever. As the result of investigations, the conclusion was arrived at that yellow fever is conveyed by a certain variety of mosquito, which, by its bite, introduces the disease into the blood of non-immunes. Sanitary measures for the destruction of the insect and for the screening of infected persons were at once put into effect in Havana, with the result that for more than a year no case of yellow fever has been developed there.

THE thirtieth annual dinner of the old students of the Royal School of Mines will be held on Tuesday, February 3, 1903, at the Hotel Cecil. The chair will be taken by Mr. A. C. Claudet. Tickets can be obtained from Mr. D. A. Louis, 77 Shirland Gardens, London, W.

THE fifth International Congress of Applied Chemistry will be opened in Berlin on May 31, 1903. Prof. Clemens Winkler will be honorary president, and Prof. Otto N. Witt, the president of the German committee, will occupy the chair. Dr. H. T. Böttinger is now actively engaged in securing the cooperation of British men of science. There will be twelve sections in all, at which every branch of pure and applied chemistry will be discussed.

THE annual meeting of the Geographical Association will be held on Friday, January 9, 1903, at 3.30 p.m., in the College of Preceptors, Bloomsbury Square, London, W.C. The president, Mr. Douglas W. Freshfield, will be in the chair, and will give an address. There will also be an address on the Australasian Commonwealth, by Sir John A. Cockburn, K.C.M.G., and an exhibition of maps, views and diagrams by lantern projections, illustrative of the Ordnance Survey maps, by Mr. A. W. Andrews.

THE success of the general meeting of the American Philosophical Society, held last April, established most satisfactorily the claim that the interests of useful knowledge in the United States may be greatly promoted by holding an annual general meeting of the Society. It was therefore decided to hold a second meeting, and in accordance with this resolution the meeting will take place on April 2 and 3, 1903. A strong and

representative committee was appointed to make the necessary arrangements, the chairman being Prof. George F. Barker, and secretary Mr. I. Minis Hays.

THE commission appointed a year ago by the legislature of New York to investigate and report upon the advisability of the State establishing an electrical laboratory will probably report, says the *Electrical World*, in favour of establishing such an institution, which will also serve as a standardisation bureau. It is reported that the commission has learned that the amount of capital in New York State directly interested in the development and use of electricity is 1,680,590,290 dollars, made up of 217,974,695 dollars, representing the capitalisation of the companies engaged in the manufacture of electrical apparatus, and 1,462,615,595 dollars, the capitalisation of the companies involving the use of electricity.

A PETITION to be presented to the council of the Chemical Society is now being circulated among Fellows of that body for signature, in which it is suggested that the council should take the opportunity afforded by the approaching resignation of the senior secretary, Prof. W. R. Dunstan, of limiting the period during which this office may be held, and so afford to the younger Fellows of the Society "an opportunity of gaining experience in this honourable official position." It is pointed out that such a limitation is already in force at the Royal Society.

A MEETING of the Imperial Vaccination League was held on Friday last, under the presidency of the Duke of Northumberland. The report was read by Mrs. Garrett Anderson, and it stated that the League would supply literature on the subject of vaccination for distribution, and that a body of lecturers would be organised to give addresses on the subject of smallpox and the protection which vaccination affords. In proposing the adoption of the report, the chairman referred to the extremely small fear of complications arising from vaccination now that calf lymph is used. The Bishop of Stepney, in seconding, remarked that educational work by the League was necessary in order to counteract the influence of societies opposed to vaccination. Sir Michael Foster, in moving the election of the executive committee, stated that an important point to consider was whether the sanitary authorities were the right ones to administer the Acts relating to the health of the people.

AT the annual meeting of the Yorkshire Naturalists' Union, held at Hull on December 10, Mr. W. Denison Roebuck was presented with a handsome testimonial in recognition of his past services as secretary of the Union and editor of the *Naturalist*. The presentation took the form of a beautifully illuminated address, in book form, and a clock and bronzes. References were made by many speakers to the ability with which Mr. Roebuck had worked in the interests of the Union. The presidential address was afterwards delivered by Mr. P. F. Kendall, his subject being "Problems in the Distribution of Animals and Plants." The new secretary is Mr. T. Sheppard, of the Municipal Museum, Hull, and the *Naturalist* will in future be edited by Mr. Sheppard and Mr. T. W. Woodhead, of Huddersfield. The president for 1903 is Mr. Roebuck, and Mr. J. H. Howarth is the treasurer.

THE Zoological Society of New York has acquired the Aquarium, which stands in Battery Park, New York City. It has been transferred to the Society by the City upon terms which provide for the entire control and management of the Aquarium by the Society and for an adequate maintenance of it by the City. The Society has appointed Mr. Charles H. Townshend, late of the United States Fish Commission, as director of the Aquarium. With him will be associated an advisory committee of experts, and the Aquarium will be managed by the Society in the same manner as the Zoological Park.

DR. J. W. B. GUNNING, Director of the Pretoria Museum and Zoological Gardens, sends us a long list of the additions to the menagerie of that institution which have been made during recent months. Amongst them is the celebrated lioness "Beauty," commonly called "Kruger's Lion," which was originally presented by the late Mr. Rhodes to the Pretoria Gardens in 1899 and returned to the donor by Mr. Kruger's orders. Mr. Rhodes then gave it to the Zoological Society of London, in whose gardens it remained for two years. At the special request of the authorities at Pretoria, the lioness was sent back there in July last, Mr. Rhodes's executors having signified their approval of this being done.

BY the death of Mr. Henry Stopes, the science of prehistoric archæology has lost an enthusiastic student and an indefatigable collector. By profession Mr. Stopes was an engineer, and he more particularly interested himself in Palæolithic implements viewed from the standpoint of a practical mechanic. He amassed an enormous collection of Palæolithic implements of all sorts, rightly judging that long series were all important in scientific study. He held that more could usually be learned from a rude or from an imperfect or unfinished implement than from the typical finished product, and thus he eagerly collected the "wasters" and the ruder and unfinished forms. In a short paper published in the *Journal* of the Anthropological Institute (vol. xxix., 1899, p. 302), he announced the discovery of *Neritina fluviatilis*, with a Pleistocene fauna and worked flints in high terrace gravels of the Thames valley, and in the following volume of the same *Journal* (p. 299) he published a paper on "Unclassified Worked Flints," illustrated by numerous specimens.

THE following candidates have been nominated for the Fellowship of the Reale Accademia dei Lincei:—As corresponding Fellows, Profs. Beccari, Donati, Lustig, Parona, Pascal and Venturi; as foreign Fellows, Profs. Lorentz, Thalèn, de Vries, Wiesner and Zeuthen. The Academy has been singularly unfortunate in its loss during the summer recess of the four ordinary Fellows General Annibale Ferrero, Prof. Adolfo Targioni-Tozzetti, Prof. Alfonso Cossa and Prof. Riccardo Felici, one corresponding Fellow, Prof. Magnaghi, and, on the list of foreign Fellows, Profs. Faye and Virchow. General Annibale Ferrero took a prominent part from the outset in the work of the International Geodetic Association. He held office in 1872 as head of the geodetic division of the Italian Military Topographical Institution, in 1893 as director of the Military Geographical Institution, from 1873–83 as secretary, and from 1883 as president, of the Royal Geodetic Commission for Italy, from 1891 to 1897 as vice-president of the Permanent Commission of the International Geodetic Association, and from 1897 until his death as president of the Association itself. Prof. Adolfo Targioni-Tozzetti started his career as a botanist, but in 1866 was elected to the chair of comparative anatomy and invertebrate zoology at Florence. In 1875, he was appointed director of the newly-formed Department of Agricultural Entomology at Florence. His most important writings are on entomological subjects, and include papers on the luminous organs of the Italian "lucciole," the classification of the Orthoptera and the vine diseases oidium and phylloxera. Alfonso Cossa was first assistant lecturer at Pavia in materia medica and botany; he subsequently held an appointment there as professor of chemistry and director of the Technical Institution; from 1866 to 1871 he was principal of a new technical institution at Udine, and then at Turin he held various posts, culminating in 1882 in a chair of chemistry

in the Engineering School of Valentino. His writings deal with agricultural chemistry, mineralogy and electro-chemistry, and his name has been perpetuated in the mineral Cossaite.

MR. E. ERNEST LOWE, curator of the Plymouth Museum and Art Gallery, sends a description and sketch of a portion of a mammalian tooth found by Mr. F. Leslie Sara, of Yelverton, in a cave in the Mendip Hills, Somersetshire. Mr. Lowe has identified the object, the greatest length of which is nearly six inches, as the terminal portion of one of the lower canine teeth of *Hippopotamus amphibius*. "The grinding surface of the tooth," he remarks, "is closely striated, and in the centre the striæ are so close and deep as to form a distinct groove, whereas all the recent hippopotamus teeth I have been able to examine have a *smooth* grinding surface. At the point of the tooth, the enamel is chipped as if from a blow. At first sight, the specimen appears to have been cut from the complete tooth with a modern saw, but I am assured it is exactly as found. The cut end was exposed on the surface of the clayey ground." Mr. Lowe suggests that the tooth is a prehistoric flint-flaker or axe-head of a unique character, but an authority to whom we have submitted the matter informs us that *fossil* hippopotamus tusks exhibit a structure exactly similar to that described by our correspondent. It is due to disintegration of the ivory along the lines of growth.

IN the *Journal* of the Society of Arts for December 5, there is a paper by Mr. Alfred Watkins on some aspects of photographic development, setting forth the methods of work that have become associated with the author's name. A few observations recorded appear to be new, as, for example, that an increase of iodide in a rapid emulsion may increase the multiplying factor for development, and that a little iodide of potassium in the developer causes the image to appear almost as quickly at the back of the plate as at the front. The tendency appears to be to find new circumstances that interfere with the most usual course of events in development, and from the discussion that followed the paper we gather that at least some authorities still regard Mr. Watkins's generalisations as of rather too sweeping a character.

DR. G. HELLMANN has recently published the sixth of his useful discussions of the rainfall of the Prussian States, prepared at the request of the German Meteorological Office. The part now in question refers to the Provinces of Schleswig-Holstein and Hanover; the annual distribution of rainfall is clearly delineated, as before, on a coloured map showing the amounts for each 50 millimetres from 450 to 1400, and upwards, with an inset exhibiting the interesting values for the district of the Hartz Mountains. Particular attention is given to the greatest falls in one day, and shorter intervals, as being of considerable utility to engineers and others. The variations in the annual amounts at the same localities are, as usual, very considerable, and depend upon laws of which little is known at present, the rainfall of a wet year being occasionally double the amount of that in a dry year.

WE have received vol. xi. of *Deutsche überseeische meteorologische Beobachtungen*, published by the Deutsche Seewarte, containing the meteorological observations made in German East Africa, collected and discussed by Dr. H. Maurer. The observations were made at thirty-three stations; some of them date back as far as 1894, and some have been published in other places. Although the series is not complete and the observations are acknowledged to be not all of the same quality, they give, in the main features, a useful representation of the climate of a large district hitherto but little known. In bringing the data together in one volume, by very carefully collating them on the most approved plan and by giving full particulars of the stations and instruments, the Seewarte has rendered a great service to meteorological science.

MR. FREDERIC J. CHESHIRE describes, in the *Journal* of the Quekett Microscopical Club, a simple form of reflecting polariser. It consists of a single glass reflecting surface fixed at a constant angle of $33\frac{1}{2}°$ with the axis of the microscope in the position commonly occupied by the mirror, and capable of rotation about that axis without varying the inclination. The author points out the advantage of the increased field as compared with that obtained with a moderate sized Nicol's prism.

THE November issue of the *Journal* of the Franklin Institute contains an interesting paper on the conversion of amorphous carbon to graphite, by Mr. F. J. FitzGerald, chemist to the Acheson Graphite Company. The paper is largely historical, the experiments of Despretz, Berthelot, Moissan and others being described in some detail.

SHORTLY after the great Indian earthquake of June 12, 1897, a duplex pendulum seismograph was erected at Shillong, a town lying just within the epicentral area of the earthquake. The records of this instrument from August, 1897, to the end of 1901 have recently been examined by Mr. R. D. Oldham in order to ascertain if any traces of tidal influence were to be detected in the occurrence of shocks in what at that time was an extremely unstable portion of the earth's crust. Mr. Oldham arrives at the following conclusions, which, however, he regards as provisional and requiring verification from a more extended series of observations. There is, in the first place, a large variation in the diurnal distribution of earthquakes, maxima of frequency occurring between 10 and 11 p.m. and between 6 and 7 a.m. Superimposed on this large but unexplained variation in frequency, there is a smaller variation, which has the appearance of being due to the tidal stresses set up by the attraction of the sun. Also, if this smaller variation is really due to tidal stresses, then the horizontal stress is much more efficient than the vertical stress, and the effect is less due to the amount of the stress than to the rate and range of its variation.

A RECONNAISSANCE-SURVEY of Jebel Garra and the oasis of Kurkur, which lie to the west of Assuan and the first cataract on the Nile, has been made by Dr. John Ball (Survey Department, Public Works Ministry, Cairo, 1902). Jebel Garra (540 metres above sea-level) is a huge, flat-topped hill capped by Eocene limestone, which stands on the margin of the plateau and scarps of Upper Cretaceous strata bordering the Kurkur Oasis. These overlook the low, undulating country formed of Nubian sandstone which occupies the intervening desert, where much blown sand occurs. The Kurkur Oasis is formed by the confluence of several wadies or drainage-channels, which have no outlet, and it contains two wells. There is little hope of the oasis being able to maintain more than a few human beings, and at present there are no residents. The water occurs at an altitude of 330 metres, and it appears to be derived rather from local rain water, which drains through the Cretaceous white limestone, than from any more permanent underground supply.

AN analysis by Mr. Radcliffe Hall of the volcanic dust which fell at Barbadoes on October 16 agrees in a general way with Dr. Pollard's analysis of the dust of May 7 (see NATURE, June 5). The material analysed by Mr. Hall contained rather more alumina and alkalis than that analysed by Dr. Pollard, and less magnesia; facts which point to the conclusion that felspar and possibly also glass are more abundant in the October than in the May dust.

A JOINT commission appointed by the Royal Society and the London School of Tropical Medicine has been investigating the African sleeping sickness. This disease, endemic in the Congo basin, has recently been spreading eastwards with great rapidity, causing a terrible mortality. Of the commissioners, Dr. Christie and Dr. Low (Craggs research student of the London School of Tropical Medicine) are returning home, but Dr. Castellani is remaining to complete his investigations. The latter has isolated a streptococcus which seems to be the specific cause of the disease. The *rôle* of the *Filaria perstans* as the causative agent has been disproved by the commission.

A NUMBER of cases of serious anæmia having occurred in the Dolcoath mine, Cornwall, an inquiry was instituted by the Home Office into the cause of the affection. Dr. Haldane, with whom was afterwards associated Dr. Boycott, made the interesting discovery that the condition was one of ankylostomiasis, which is due to the presence of an intestinal parasite, the *Ankylostomum duodenale.* This disease is almost confined to tropical countries, though it was met with among the navvies employed in the piercing of the St. Gothard tunnel. Doubtless, in the present instance, some of the miners who had been working abroad contracted the disease and brought the infection home with them.

IN the December number of the *Entomologist*, Mr. E. Bagwell-Purefoy gives further information with regard to the successful introduction of the brimstone butterfly into Tipperary, which was accomplished in 1894, after its feeding-plants had been planted a few years previously in the county. This butterfly —the *Gonepteryx rhamni* of some authors and the *Colias rhamni* of others—is found at Killarney and has been reported from Wicklow, but is not a native of any other part of Ireland. In 1896, the colony of Tipperary was found to be in a flourishing condition, and in 1901 and the present year had still further multiplied. During the past summer, Mr. Purefoy has attempted to introduce the handsome Mediterranean brimstone *G.* (or *C.*) *cleopatra* into the same district—an experiment which will be watched with interest.

IN the September issue of the *Proceedings* of the Philadelphia Academy, Miss A. M. Fields records the results of experiments made with a view of ascertaining the cause of the hostility to one another displayed by different colonies of ants of the same species, and likewise the influence of light of different colours on these insects. The chief cause of the hostility of one colony to another appears to be a difference of odour accompanied by a difference in the age of the individuals composing the two colonies. As regards colours, it is inferred that ants are able to distinguish some of these, but may have no preference for one more than another. Also that these insects gradually lose their natural dislike of light by exposure to its influence.

THE remarkable differences in the life-history of different colonies of an American land-planarian (*Planaria maculata*) form the subject of a paper by Mr. W. C. Curtis in a recent issue (vol. xxx. No. 7) of the *Proceedings* of the Boston (U.S A.) Natural History Society. In certain localities, the creature apparently reproduces its kind exclusively by fission, while in others sexual reproduction occurs. There are yet other districts in which both modes take place. It is suggested that the asexual may replace the sexual mode of reproduction in the same individuals, but to confirm or disprove this, an extended period of observation is essential.

THE third volume of Mr. W. S. Taggart's "Cotton Spinning" (Messrs. Macmillan and Co., Ltd.) has reached a second edition. The first two volumes deal with the preparing processes in cotton spinning, while this part takes up the subject of spinning and the preparation of yarns. Necessary additions have been made to the new edition so as to bring the book up to date.

IN the Christmas number of *Photography*, Messrs. Iliffe and Sons, Ltd., have presented us with an excellent and inexpensive publication, printed on good paper and studded with numerous fine illustrations by various processes. This number has set itself the task of reviewing and displaying the most choice samples that have been shown to the public at the two great exhibitions held at the New and Dudley Galleries this year. A short but interesting monograph accompanies each illustration, drawing the reader's attention to the chief points. The publishers seem to have spared no pains to make the production, as a whole, high class in every respect, and the book will be found useful and valuable as illustrating types of subjects and treatments which are utilised and cultivated at the present time.

THE additions to the Zoological Society's Gardens during the past week include a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mr. E. Bieber; a Banded Ichneumon (*Crossarchus fasiatus*) from Mozambique, presented by Mr. F. D. Samuel; a Raven (*Corvus corax*) British, presented by Mrs. Rose Haig Thomas; a Douglass's Horned Lizard (*Phrynosoma douglassi*) from the Rocky Mountains, presented by Mr. C. W. H. Doubler; a Hog Deer (*Cervus porcinus*) born in the Gardens.

ERRATUM.—In letter on p. 126, col. 2, l. 45, for "red out" read "red."

OUR ASTRONOMICAL COLUMN.

COMET 1902 *b* (GIACOBINI).—Further observations of this comet have been communicated to the *Astronomische Nachrichten* (No. 3833).

Mr. C. F. Pechule, of Copenhagen, made the following observation on December 3:—

14h. 38m. 20s. M.T. Copenhagen. $\Delta\alpha = -$1m. 22s.·00. $\Delta\delta = +1' \ 53''·7$. α (app.) = 7h. 17m. 26s.·56. δ (app.) = $-1^\circ \ 51' \ 18''·0$, faint, 12th magnitude, small, diffuse.

NEW VARIABLE STARS.—*Algol Variable*, 20, 1902, *Cygni.* —From photographs obtained by M. S. Blakjo, Madame Ceraski has found that the star having the position (1855) α = 21h. 0m. 44s.·6, $\delta = +45^\circ \ 11' \ 53''$, is a variable, and a further examination of ten plates indicates that it is a variable of the Algol type.

18, 1902, *Coronae.*—Mr. Thomas Anderson has observed that the star having the approximate position R.A. = 16h. 10m.·3, Dec. = $+38^\circ \ 8'$, (1855), has been rapidly decreasing in brightness during November.

The following magnitudes have been observed:—November 1, 8·5; November 7, 8·7; November 18, 9·2; November 21, 9·3.

19, 1902, *Pegasi.*—Mr. Anderson also records the variability of the star having the position R. A. = 21h. 57m.·8, Dec. = $+34^\circ \ 25'$ (1855). At maximum, its magnitude is midway between 9·1 and 9·9, whilst at minimum it is only 0·2m. brighter than a neighbouring 11th-magnitude star. Its period is seven months (*Astronomische Nachrichten*, No. 3831).

HERSCHEL'S NEBULOUS REGIONS OF THE HEAVENS.—Dr. Isaac Roberts has recently completed his photographic survey of the fifty-two regions of the heavens described by William Herschel, in his paper "The Construction of the Heavens" (*Phil. Trans.*, 1811), as exhibiting extensive diffused nebulosity, and has communicated the results of this survey to the Royal Astronomical Society (*The Observatory*, No. 325).

Using a 20 inch reflector and a 5-inch Cooke lens to obtain simultaneous photographs, he has obtained negatives showing stars of magnitude 16–17 with the former, and of magnitude 14–15 with the latter instrument, thus securing images of objects at least as faint as those shown by Herschel's telescopes.

These photographs show that in forty-eight cases out of the fifty-two there is no trace of the extensive diffused nebulosity described by Herschel. On the remaining four, there is nebulosity which forms parts of three extensive nebulous clouds, which, however, Herschel could not have seen in so complete a form as they are shown on the photographs.

NEW MINOR PLANETS.—Prof. Max Wolf announces, in No. 3831 of the *Astronomische Nachrichten*, the discovery of

nine new minor planets. Three of these were found on a plate taken by Prof. Wolf on November 20, three others on a plate taken by Mr. Dugan on November 21, and the remaining three were found on a plate secured by Prof. Wolf on November 21.

ELEMENTS AND EPHEMERIS OF COMET 1902 *d*.—M. G. Fayet, of the Paris Observatory, has computed the following elements and ephemeris for the orbit of the new comet, from observations made on December 3, 5 and 8:—

T = 1903 March 13·976 M.T. Paris.

$$\left.\begin{array}{rl}\pi = & 119^\circ\ 52'\ 40''\\ \Omega = & 117\ \ 39\ \ 21\\ i = & 43\ \ 53\ \ \ 9\\ \log q = & 0{\cdot}45401\end{array}\right\}1902$$

Ephemeris 12h. M.T. Paris.

1902	α h. m. s.	δ ° ′	log Δ	Brightness.
Dec. 11	7 14 47	−0 39·1	0·3339	1·1
15	7 12 58	+0 4·5	0·3255	1·2
19	7 10 52	+0 52·8	0·3179	1·2
23	7 8 33	+1 45·8	0·3110	1·3
27	7 6 1	+2 43·3	0·3049	1·3
31	7 3 18	+3 45·1	0·2999	1·4

Brightness at time of discovery = 1.

An observation was made on December 10d. 13h. 37m.·0 at Heidelberg by M. Courvoisier, and gave the following position for the comet:—108° 47′ 12″, − 0° 48′ 15″, and this gives a correction to Fayet's ephemeris of −2s. and +0′·6 (Kiel *Circular*, No. 55).

"COMPANION TO 'THE OBSERVATORY,' 1903."—This annual collection of elements and ephemerides, just published, contains its usual excellent list of tables and information in regard to the astronomical phenomena which will take place during the coming year.

The information concerning the various meteor showers and double stars is supplied by Messrs. Denning and Maw respectively, and M. Loewy has again contributed advance proofs from which the variable-star ephemerides have been compiled. The latter show a considerable increase in number this year.

JUPITER AND HIS GREAT RED SPOT.

THOUGH Jupiter has been unfavourably placed for European observers during the present year, his surface markings have been extremely interesting, of great variety and in plentiful numbers. The English climate, even at its best, can scarcely be said to suit astronomical work in an eminent degree, but its characteristics in 1902 have proved unusually bad, in fact, atmospheric conditions have combined with the low position of the planet to render observations difficult, and they have generally had to be pursued with definition of very inferior quality. The seeing has been recorded as "very good" on six nights only out of seventy-five, and in 1901 the result was equally disappointing, for the image was really sharp and satisfactory on five nights only out of seventy-one; but in 1901 the planet was about 5° lower (Dec. 23° S.) than in 1902 (Dec. 18° S.), and though the difference is not great, it ought to have operated strongly in favour of the present year had other circumstances been equal.

The most noteworthy incident in connection with recent studies of Jupiter is to be found in a very pronounced acceleration of motion in the great red spot. This first made itself evident in 1901, but it has been intensified during the past summer. For about twenty-three years, uninterruptedly, this singular marking had exhibited a constantly increasing retardation, which caused its rotation period to lengthen from about 9h. 55m. 34s. to nearly 9h. 55m. 42s. But in 1901 it declined to 9h. 55m. 41s., and during the present year the rate has been about 9h. 55m. 39½s. And this increase of velocity has been contemporary with the outbreak of a large, irregular or multiple marking of a dusky hue, in the same latitude of the planet. This new object, apparently first seen in May, 1901, has shown a rotation period of 9h. 55m. 18s., which corresponds with that of the south temperate current. It seems a probable conjecture that the presence of the marking just referred to may have forced the red spot along at a more rapid rate than that which it exhibited in previous years. In June, July and August of the present year, the red spot was almost surrounded by the material of the new marking, and the quicker motion of the latter may well have accelerated the movement of the former. But no certain conclusion can be arrived at, though the facts are significant and suggestive. Possibly the phenomena alluded to may have been practically coincident in date, but devoid of any physical relationship. And in this connection it will be useful to remember that the red spot has always been situated in a stream flowing along with much greater celerity than the rate of its own motion.

In September, the material of the new marking had passed to the preceding (W.) side of the red spot, and hence it was expected that the accelerated motion of the latter would cease, but the differences in motion have been comparatively slight, so that errors of observation make it unsafe to form definite conclusions. It will be advisable when the planet disappears from the evening sky in January next to collect all the transit times of the red spot recorded during the present apparition, as it may then be possible to determine with accuracy the extent of the acceleration and the variation in its rate, if any, during the summer and autumn. If a large number of observations are forthcoming, it will be desirable to group them into monthly or bi-monthly periods and ascertain the mean longitude of the spot for each of these, when the rate of its drift will be seen and the errors of individual transits practically obliterated.

At Bristol, the following estimated transits have been obtained with a 10 inch reflector and a power of 312:—

Date. 1902.	G.M.T. h. m.	Longitude. °
April 28	16 14	45·9
May 20	14 23	44·7
June 20	14 56	44·8
,, 27	15 37	42·2
July 2	14 49	45·1
,, 7	13 54	43·9
,, 9	15 33	44·5
Aug. 8	10 8	40·2
,, 12	13 29	41·7
,, 15	10 57	42·5
,, 20	10 3	41·7
,, 25	9 7	39·6
Sept. 1	9 50	38·0
,, 13	9 48	40·3
,, 18	8 56½	40·5
,, 28	7 9	37·9
Oct. 3	6 18	37·9
,, 10	7 9	40·2
,, 15	6 13	37·1
,, 22	7 1	37·1
Nov. 8	6 8	36·9
,, 18	4 31½	39·4
,, 23	3 36	36·1
,, 25	5 20	39·1

During the present year, a number of white and dark spots have been visible on the north side of the north equatorial belt, and the mean rotation period of these has been about ten seconds less than that shown by the red spot. A new belt has lately formed on the northern side of the spots alluded to. The equatorial current of the planet has been moving, as nearly as possible, at the same rate as during 1901, for the mean rotation of twenty-four spots is about 9h. 50m. 29s. There has been an abundance of slow-moving N. and N.N. temperate markings, but these have seldom been well seen owing to the confused definition.

W. F. DENNING.

SOME LIMITS IN HEAVY ELECTRICAL ENGINEERING.[1]

IT is customary for a presidential address to be a review of the development of the science with which the Institution is particularly concerned. Such a review is especially beneficial in the case of such a rapidly growing industry as electrical engineering, as the outlook changes considerably during a year. Instead of a review of the past, a dream of the future may take the form of a presidential address. This form has great

[1] Abridged from the inaugural address by the president of the Institution of Electrical Engineers, Mr. James Swinburne.

attractions for me for several reasons. In the first place, this kind of prophecy is easy and pleasant. I might draw a rosy picture of a future when everything conceivable is done electrically. We shall have electrical energy developed direct from carbon at the coal-pits. Not only all our lighting, but all our domestic heating will be done electrically. There will be no smoke in our cities or in what will correspond to them. Most of the dirt of our houses will have vanished. Large and crowded towns will have disappeared, because the telegraph will have given way to its wireless rival, and that will have given way to the wireless telephone with no exchanges and no subscriptions. There will thus be no need for people to go and see one another to transact business. Even when matters must be written to preserve a record, no office will be necessary. You will dictate by wireless telephony to your shorthand clerk at his distant house. Perhaps we shall all learn shorthand instead of our present cumbersome system of writing, and all books and letters will be in one language, written and printed phonetically at speaking speed or faster. The horse will have gone, leaving clean and odourless streets, with smooth surfaces on which people will travel in rapid electric automobiles. The railways with very rapid long-distance service will be entirely electric. It is very easy to prophesy in this sort of way, not only in a general way, but in considerable detail; and it is an amusement that brings much credit to the prophet. If any of his prophecies seem unlikely to come true, he merely has to say, "Wait a little!" While if anything like what he foretells comes into existence, say twenty years hence, all he has to do is to refer back to an address to claim that he has foretold it, and the future inventor will have half his credit taken from him and given to the prophet. If the prophecies are sufficiently vague, there is certain to be some sort of fulfilment of some of them sooner or later, and it is always well to have a good many past publications of this sort in stock waiting for future development.

Great though the temptation is, I will resist it, and try to look into the future from quite a different point of view. We have been going ahead so very fast lately—even our acceleration itself increasing—that we may be a little apt to have vague views of what we can and what we cannot do electrically. It may be well, therefore, to try to look over some of the branches of our great and diverse industry, and see what obstacles are now opposing us and what are likely to oppose us shortly, and whether the obstacles are insuperable or not. This sort of prophecy is much more difficult than the other, for there can be no credit twenty years hence in having said something could not be done, even if it has not, while if it has been accomplished the position is still more difficult. Negative prophecy is thus unattractive. But the discussion of our limits may not only have a beneficial effect in making us modest, but it may be a much greater benefit if, by focussing our attention on a limit of any development, we find either that the obstacle is theoretically insurmountable, in which case we must go round it, or that it has to be scaled in a particular way.

There are clearly at least two kinds of obstacles. For instance, it is obviously impossible to get more than 746 watts out of a dynamo taking one horse-power to drive it. But the limit of possible speed on an electric railway belongs to quite a different category. I will therefore discuss various branches of electrical technology, to see what may prevent or is preventing further advance.

Twenty years ago, this Institution was chiefly concerned with the development of the telegraph. We can get but few telegraph papers now. This is not because telegraphy is dead; it is because most of its problems are solved, so there is little to discuss. The fact that there is little to discuss in telegraphy is the proof of its vitality. It has passed out of the childhood of technical difficulties into the manhood of commercial development. Ten years ago, we were in the thick of the evolution of the dynamo and the transformer. Now there is little but detail to discuss about electrical generating machinery. This is because heavy electrical machinery has got through its difficult infancy and is now a trade, which is the highest compliment that can be paid to it. But we electrical engineers have also developed through our difficult training into being the scientific branch of the engineering profession. Our exactness of calculation and measurement has leavened the steam engineers and the other manufacturers with whom we have to work in concert.

No one man can be a complete electrical engineer; but each of us ought to know one subject well and a large number of allied subjects fairly well. As a basis of technical knowledge, which I am alone dealing with to-night, we must have a fairly all-round knowledge of "theoretical" physics and chemistry. Physics is merely unapplied engineering. Science is split—unfortunately, the split is very difficult to heal—into two parts, generally wrongly called the theory and the practice; or pure and applied science. This fissure is not so deep in our branch of engineering, but it is there. Science, to be worthy of the name, is knowledge of Nature utilised by man. Engineering is science, and science is engineering. You can cut off a part and call it unapplied science. This is what is generally known as theory or pure science. It is not purer than any other science, and the term theory is misapplied. To be an engineer you must know both branches. There is nothing superior about knowledge which is not yet applied. It is mere raw material; it may be useful when worked up, and it is valuable before it is worked up, but only because it may be worked up. The so-called practical man who works at applications without understanding the generalised principles is ignorant. He only understands a part of science. The so-called scientific man who only understands what is called pure science is just as ignorant. Each understands part of his subject only.

We as electrical engineers ought especially to heal the split between the halves of science; a split which is much deeper in other branches of engineering, such as chemical and purely mechanical. We ought to unite knowledge of both branches of science in one individual as much as possible.

Tides.

The tides are often referred to as a possible source of energy even to this day; and it is urged that in places where the tide rises abnormally, for instance in the estuary of the Severn, it would pay to make a dam with turbines. The sort of argument is that if you have an area of, say, 1000 square metres and a total rise of 15 metres, you have 15,000 cubic metres of water, and as this runs in twice and out twice a day, you have 15,000 cubic metres of water, falling the equivalent of 60 metres a day, or approximately 100 kilowatts. This statement contains many fallacies. In the first place, in order to get the full advantage of the difference of level, the water must be let in and out at high and low tide only. Even then the equivalent or average head during discharge or charge is only $7\frac{1}{2}$ metres. But a system which gave an enormous power for a very short time four times a day would be of no use. The plant would be expensive and the result of no value. With a single tank it is impossible to get a continuous output. If the tide is coming in and you get power by letting the tide fill the tank, the power will decrease to zero as the tide begins to fall and comes to the same level as the water in the tank. It is therefore necessary to have more than one tank. To make the plant practical, you want fairly constant pressure available on the turbines, though you may waste head by sluices or valves. It is often said that a Norwegian fiord or a Scotch loch could be easily dammed and utilised, but it would be impossible to find three lochs all opening out together. The need for more than one reservoir does not seem to have been recognised. In addition, the demand for electrical energy on Scotch lochs or Norwegian fiords is rather minute.

Water Power.

Some years ago, there was a great deal of excitement about the development of water powers. The possibility of "harnessing Niagara" and utilising waterfalls all over the world was hailed as a great triumph over Nature, and the idea was that power could be got for nothing, and industries would all migrate from coal districts to the neighbourhood of water powers. The daily Press and the magazines took the matter up, and there is something in the idea of saving some of the colossal waste of natural energy that appealed especially to the half-scientific or unpractical reader. At the time of the excitement, it was pointed out, largely in vain, that water power did not cost nothing, because the development of a fall demanded a good deal of capital, on which interest and depreciation had to be paid. But further than this, Ricardo's theory of rent is applicable to water powers as well as to arable land. If steam power costs a farthing a unit, and if water power at the same place can be produced for half a farthing, after paying working expenses and interest, the owner of the water power will claim the odd half farthing as rent, or will just allow the water power enough to encourage the production of a new thing. As a rule, however, a water

power is not where it is wanted industrially. In the nature of things, water powers are generally in hilly countries, and are seldom near the sea. The result is that a water power as a rule cannot command the same price as steam or gas, because it is not where it is wanted. The idea in starting many of the water-power stations also was that works which needed power would come and settle near. As a matter of fact, the cost of power is a much smaller item in most industries than is generally supposed, and it does not pay to start a works in an otherwise not perfectly suitable locality simply for the sake of the cheap water power. In such industries as engine building, flour milling, spinning and weaving, and so on, the chance of reducing the expense for power is not enough to overcome other considerations. It may be said that in electro-metallurgical processes the whole cost is practically the electrical energy, and so carbides, aluminium, electrolytic soda and chlorate of potash will be made at water powers. Even this, however, is misleading. Carbides and aluminium are generally made at waterfalls, and chlorate nearly always is. Electrolytic soda and bleach are made at water powers, but are also made extensively by steam-driven plant. Against the cheaper power, we have to put extra carriage for materials and for coal, which is often needed in addition, and extra carriage for finished products, and very often extra cost of labour, as labour is often dear and bad in water-power districts. It may thus easily pay to use much more expensive power if the other conditions are more favourable. Steam power, for instance, will cost three or three-and-a-half times as much, and yet it pays to make electrolytic caustic and bleach in England where the other conditions are all favourable. It is not, therefore, the want of water power that has kept the electrolytic industry back in this country. For a water power to be really valuable, it should be near a source of material, on the sea, and should have a great head of water, so that the capital cost of development is small. Such a water power is very valuable—to the landlord.

A blast furnace is more valuable than a water power. There are plenty in England. But the owners, who have been wasting the gas up to now, will not give it away; they will want rent, so that it will only just pay to use this gas rather than make it. The electrical industry thus does not gain, but the ironmasters do.

Carbon Cells.

For many years, "electrical energy direct from coal" has been the dream of the electro-chemist. That is to say, he has dreamed of an electrolytic cell in which the consumed electrode is carbon. The best way to realise the difficulties of this problem is to consider it solved and see what it means. The carbon must be in contact with an electrolyte, and that electrolyte must either be in contact with a second electrolyte which wets the other electrode or must itself be in contact with that electrode. This second electrode must almost certainly be metal, as there are no other non-metallic conductors available. Such compounds as the hydrides, nitride, oxides, chloride, bromide, or the sulphide, or silicide, of carbon are not salts in the electrolytic sense. Carbon forms part of the electro-positive radicle in the organic radicles and part of the electro-negative radicle in the cyanogen compounds, but it is never a radicle by itself. To sum up the matter shortly in the light of modern theory, carbon never forms ions, and has therefore no solution pressure, and can therefore give no electromotive force. At ordinary or moderate temperatures, carbon is practically inert. Oxidising agents will attack some forms slightly, and sulphuric acid will attack it. In this latter case, the formation of water and its combination with the acid is the determining factor. At high temperatures, oxygen, sulphur, silicon, and to some extent nitrogen, and many of the metals combine with carbon, but there is no dissociable salt of carbon formed. The carbon cell thus seems impossible. Such schemes as Mr. Reed's, ingenious as it is, is not a solution of the problem. It would be simpler to reduce zinc oxide with the carbon and then put it in a zinc cell.

It is hardly necessary to discuss thermopiles or thermomagnetic engines as possible economical producers of electric power.

Steam Engines.

The primary question in all heat motors is, What temperature range is available? In the case of a steam engine, there is enormous waste of mutivity—to use a variation of Lord Kelvin's convenient term—in boiler flues. We burn carbon and hydrogen, capable even with air of giving a temperature of some 1500° C., and the heat is degraded down to some 200° C. That is to say, instead of getting the heat with a mutivity of about 0·825, we degrade it down to, say, 0·35, a clear loss of 0·45 out of 0·8, or 56 per cent. This degradation is apart from the efficiency; the efficiency is concerned with the loss of heat up the chimney. The higher limit in large modern reciprocating engines may be taken, roughly, at 600° A. (327 C. or 620° F). Above this, there is difficulty in lubrication and to some extent weakening of the material. The pressure corresponding to this temperature for saturated steam is out of the question, and the pressure may be taken at, say, 12·5 megadynes per square centimetre or 12½ atmospheres, or 200 lb. per square inch, and steam leaving the boiler superheated to 600° A. does not get at the cylinder lubrication at that temperature. Our limits in the steam engine are thus pretty clearly defined. The pressure is the essential factor. Superheating is not much good in the way of getting higher mutivity in the boiler, nor is it very important in getting much more energy into the steam.

The turbine is under the same limit as regards pressure; in fact, high pressures are perhaps even more difficult to use, and superheating does not, as already explained, seriously increase the mutivity of the heat taken in by the boiler.

One of the chief disadvantages of steam engines for stations with small load-factors is the difficulty of storing energy so as to get uniform boiler load. Batteries are no longer used for this, and the difficulty reduces the value of steam in comparison with the gas engine. Mr. Druitt Halpin has proposed, and used, "thermal storage." Lagged vessels are filled with water raised to the temperature of the working steam. This arrangement, however, is not isothermic; that is to say, to get out the energy the temperature must fall. What is wanted is a reservoir containing something which undergoes a physical or chemical isothermal change. For instance, a substance that fuses at the right temperature and has a high latent heat of fusion, or a substance which, like sulphur, changes allotropically with considerable change of internal energy, at a suitable temperature. Unfortunately, there is no substance within the range of practical engineering. Moreover, the storage is on the wrong side of the engine. To store heat with a mutivity of only some 0·35 is not so promising as to store some higher form of energy. The secondary battery thus begins with an apparent advantage. The difficulty of storage is another drawback to the steam engine, and gives the gas engine a further advantage.

The Gas Engine.

There is no other comprehensive name that covers the type of engine worked by gas and oil. The combustion need not be internal, and perhaps will not be internal in the future, but in a sense all are worked by gases.

We have in the gas engine a machine which, from a thermodynamical point of view, ought to be exceedingly good; but the difficulties in building, especially very large engines to utilise the high possible mutivity and saving by having the heat produced where used, reduce the efficiency of the gas engine enormously. In spite of that, the large gas engine seems likely to oust the steam engine for large powers during the next few years. The best way to get a high efficiency out of a gas engine would probably be to make it compound, exhausting at a temperature suitable for raising steam. The steam engine would then exhaust at a temperature suitable for raising SO_2 vapour. But the chances are that Dowson, Mond or other producer gas will be available at such low prices that the extra steam and dioxide engines would not pay for attendance, interest and depreciation. With very cheap gas, the first thing is to make big engines, the next to make them so that they never break down, and the last thing to make them efficient. The gas engine may be, comparatively speaking, in the state Watt left the steam engine, but it will doubtless make very rapid advances, as it is in the hands of very competent and highly educated engineers.

Dynamos.

As regards efficiency, we have reached the practical limit already, for further reduction in dynamo losses would make no appreciable difference in the total efficiency of a station. In fact, we are rather following continental practice in having slow-running machines with many poles, even for direct currents, and efficiencies are perhaps lower for large machines than in the best English practice of a few years ago. This is also true as regards output from a given size. We are not likely to make much advance in dynamos now, as we are limited on

one hand by the hysteresis loss in iron, which prevents our using higher inductions in armatures, and low permeability, which limits our field and armature tooth inductions. It does not seem likely that we shall now find iron much better in either respect. Nor are we likely to find a better available conductor than pure copper. As insulator we have mica. It looks, therefore, as if we were within sight of our limits in dynamo and motor designs.

Secondary Batteries.

The secondary battery in central station work has been used as a store to equalise the load, and to reduce the running plant at the times of heavy load. Owing to the high full-load station pressure with feeder systems, the station battery is generally for use at light loads only. But the secondary battery has for a long time been on the border of success for traction work, both on tramways and on the road, and a further improvement in batteries may be expected to produce very great changes in important branches of engineering.

The first question asked is, Why do we stick to lead? The answer is that the case is very special and other things will not do. We are practically limited to lead, at any rate in acid cells. Take first the plate that oxidises on discharge. It should not dissolve in the electrolyte, as if it does the deposition and solution will be uneven, and the plate will grow trees and come to grief. This puts zinc out of court, unless some electrolyte is used which gives some insoluble salt of zinc, which does not attack zinc on open circuit, and gives a good electromotive force with it. Iron is out of court for the same reason; there is no suitable electrolyte. The strong organic acids such as trichloracetic or oxalic are apt to have their positive radicles split up by electrolysis, even if a strongly positive metal can be found with an insoluble salt. Lead is thus the only metal practically available in an acid electrolyte. Silver in hydrochloric acid would give no pressure, and the acid would be decomposed at the anode. On the other plate we need an insoluble depolariser, else a two-fluid cell must be used, involving a porous diaphragm, diffusion and impracticability. Not only must the depolariser be insoluble, but it must be converted into an insoluble body on discharge. The coating must be a conductor in one state or the other, or there will be no proper contact. In the lead cell, there is always enough peroxide and metallic lead in the coatings to secure electrical contact though the discharge product is an insulator. The depolarising coating must be connected to a conducting plate which is not attacked by local action. Lead and silver are the only available metals, and sulphuric, and perhaps phosphoric, the only acids, for the nitrate of lead is soluble and hydrochloric acid is decomposed by lead peroxide. Lead is protected by its coating of sulphate, or peroxide as the case may be. It thus seems as if we were limited almost absolutely to lead and sulphuric acid. It is wonderful that we have the lead cell at all. We owe it to the chance observation of Planté. The theory was not understood for a long time. For many years it was thought that the pressure was due to the PbO_2 and Pb changing into PbO. The acid was merely put in to make the electrolyte conduct, and sulphuric acid was used because people used it in gas voltameters, and they never thought that it ought to be as strong as practicable to give the pressure and output. The formation of lead sulphate was regarded as a difficulty to be overcome.

In the lead cell we want lightness, large capacity, cheapness, rapid discharge, efficiency and mechanical strength, and durability. These qualities are mostly antagonistic. Large capacity means rapid deterioration. Mechanical strength means weight. It is thus no use testing a cell for capacity without testing the efficiency and durability too, and so on. Published battery reports are often misleading, because they omit essential information.

Cables.

The conductor itself can hardly be improved, but there is great room for improvement in the insulation. It is largely the insulation of the cables that limits our pressures, and therefore our distances of transmission. For 1000 kilowatt cables, the cost is about a minimum for 8000 volts; above that, the cost of insulation increases faster than the cost of copper falls. It is exceedingly unlikely we have reached the limit in insulation. There is no branch of electrical engineering so important as cable making. Cables form a large portion of the capital outlay in large systems. Yet there is no branch of the industry which is run on less scientific lines. The days of secret mixtures known only to the workman who makes them may be passing away; but even now the whole art of cable-making is a question of trial and error, with a good deal of the last component. Engineers do not know now whether rubber is better than paper, nor can they tell what any particular make of cable will be like after ten years' use.

Light.

Our chief work, until lately, has been producing light. Here the inefficiency and waste is prodigious, and though it is mostly unavoidable, there is still great room for improvement. We take great care over our stations, watching every penny from the coal shovel or mechanical stoker to the station meter. We quarrel over 1 per cent. in the generators. When we get to the mains we care less, and once we have got to the consumers' meters we care nothing at all.

Practically all light is wanted for use by the human eye. The human eye is exceedingly sensitive; it is calculated to see a distant star when receiving 10^{-8} ergs per second, so that one watt would enable, say, five thousand billion people to see stars with both eyes, but it would have to be used economically. In reading a book, the eye would need much more than this; and then, as the book radiates light in half of all directions, only a little is used by the eye, so even if all the light from a source were concentrated on a book, there is enormous waste by useless radiation from the book. But the source of light does not illuminate only the book; the book probably subtends a small solid angle, so we have another source of waste. The eyes reading a book in a fairly good light want something of the order of two ergs per second, so that a watt would only work the optic nerves of, say, the inhabitants of London. But the book, say 200 square centimetres, would need about 3000 ergs a second to illuminate it. A candle, which gives a light of 4π, radiates about 0·2 watt, or five candles a watt; that is to say, at an efficiency of unity, we would get five candle-power or 20 units of light per watt. The efficiency of a glow-lamp is only about 0·25 candle-power per watt, or 0·05, so there is room for improvement. The first thing, naturally, is to see what limits there are in the way of increased efficiency. The obvious goal is direct production of "light without heat," by which is meant producing only the rays of wave-lengths which affect the eye.

There is no thermodynamical reason why electrical energy should not be converted directly into radiation of any wave-length without loss; I do not know if there is any molecular impossibility, but apparently our limits are practical—that is to say, it may be done, but we have not yet hit on the way of doing it. The vacuum tube appears to be a means of converting electric power direct into radiation. The Cooper-Hewitt lamp, for instance, gives an efficiency of about three candles per watt, or something like 0·6. All these figures as to light are a little vague. Unfortunately, the light is of a very bad colour. It is very actinic, but the wave-lengths are too small. One method is to degrade the light by making it act on silk dyed with matters which lower the radiation to a redder colour by fluorescence.

The Arc Light.

The arc has been very fully studied in some directions and not in others. Most makers of arc lamps seem to devote their whole attention to the mechanism, and look upon the arc merely as a hot gap that has to be preserved by suitable apparatus. Many lamp makers, on the other hand, have records of exhaustive experiments on the relations of the pressure, current and light with different carbons; but they are very seldom published. On the other hand, an enormous amount of laborious experiment on such points as these is available, and on the back electromotive force of the arc. The physics of the arc, an exceedingly difficult branch of study, has not received much systematic attention yet. The crater of an arc is, no doubt, heated to the point of volatilisation of carbon at the pressure of the air. If other gases get at the crater, the vaporisation temperature would be less. (There is a small increase of pressure which I suggest is due to the electromagnetic effect of a current localised in a conducting fluid. This may be neglected.) The crater may be rough, as carbon, though it softens, does not melt before volatilising, and it may be merely speckled with points at its volatilising temperature, so that its brightness is not uniform. But there are so many anomalies about the arc that one cannot say anything definite with safety. For instance, if the temperature is limited by the vaporisation of carbon, what must be the specific heat of vaporisation of carbon? Where does the vapour go, and what happens to it in an enclosed lamp? In condensing into smoke, it should give light of the

same colour as the crater. If it has an enormous specific heat, it ought to raise the other pole to crater temperature where it condenses. If it is a light gas, a large portion of its specific heat of vaporisation may go to external work. Most of the upper carbon is burnt away by external air; if a pencil to match the crater is volatilised, it does not account for much power. If the vapour is very light, there must be large volumes from the upper carbon. Then what conducts? Carbon vapour alone, or mixed with a little monoxide or nitrogen, is a very good conductor at these temperatures. Does that go to show that carbon vapour dissociates like iodine or chlorine, &c.? The whole question of the physics of the arc deserves far more careful study than it has yet received, but the work is surrounded with difficulties and is really a branch of the theory of the passage of electricity through gases, a matter of the greatest scientific importance, somewhat out of our way as practical electrical engineers. But as engineers in the broader sense, we are as much interested in questions of recondite physics as of costs of generation.

To sum up as to the arc light, we do not seem to have reached our limit as to light from pure heating, because we lose a lot of light into the opposite carbon. Many attempts have been made to expose the crater freely. But, far more important than this, I would urge that the arc is not necessarily a hot body radiator only, but that it may also convert electrical power directly into light in the space between the electrodes, and this gives a chance of rising more nearly to our theoretical limit of about five candles per watt.

The Incandescent Lamp.

This simple hot carbon wire in a bulb involves the most extraordinary physical complexities. A great many curious things go on inside the simple-looking globe. A good account of what is known—especially since he took the subject in hand—has been written by Dr. Fleming, and the scientific manufacture of this interesting article has been fully described by Mr. Ram. The incandescent lamp is a simple hot body radiator, and the limit of efficiency depends chiefly on the temperature of the carbon. As we are limited by the size of mains, we can only use pressures of 100 volts or 200 volts, and this limits us to carbon or something of still higher specific resistance. The sensitiveness of the carbon lamp to pressure in its turn limits the practical variation of pressure of supply, and thus costs us very heavily in mains. If we had incandescent lamps which did not mind 20 per cent. pressure variation, we would have saved millions in mains in this country alone.

The idea of making lamps of carbides has become very fashionable lately. People have put oxides into carbon for the last twenty years. The old idea is to get hold of an oxide that radiates more light at a given temperature than it ought to, which is itself a fallacy, while the idea of oxide in contact with carbon is chemically absurd. There is no oxide irreducible by hot carbon. The carbides are not by any means all refractory. Some are, though, but there are immense difficulties in making carbide lamps. To make a fine filament material of an infusible material, which can be made only at electric furnace temperatures and is generally decomposed by moist air, is not an easy task. It is easy to think you have made a carbide lamp by incorporating an oxide in the filament material, but the resulting filament is generally mostly, if not wholly, carbon. What happens to the metal in the circumstances is rather a mystery. There is, however, a chance of enlarging our limits in incandescent lamps of the ordinary kind, but it seems strange that the melting points of all known materials should suddenly reach a higher limit. Assuming the Stefan-Boltzmann law for ordinary light radiations, the fact that the efficiencies of refractory bodies all reach limits of the same order shows that the most refractory bodies melt at about the same temperature, somewhere in the neighbourhood of 3000° A. Whatever the inter-molecular forces may be that bind the particles to make solids, the vibration forces due to temperature seem to overcome the greatest at about 3000°.

Instead of an ordinary conductor, Nernst uses an electrolyte which stands a higher temperature. The conduction is electrolytic, as can easily be shown, but there are many curious phenomena, many of them so far unexplained, in the Nernst lamp. The efficiency of the Nernst lamp is about 0·6 candle per watt. It was at one time supposed to owe its efficiency to selective emission, but there is no reason to doubt that it is a pure temperature radiation.

Electric Heating.

The limit of electric heating is clearly purely financial. To convert heat into other energy with a very small efficiency and to send it out by expensive cables and then to degrade the energy down to heat again is obviously much dearer than burning coal or gas direct. But in many domestic cases, the convenience is so great that the limit is not so low as might be thought, and electric heating for cooking and other domestic uses may develop considerably. The electric arc and incandescent lamps are essentially cases of electric heating. By far the most important use of electric heating is the furnace. Here the temperature available is only limited by the volatilisation of the electrodes, and this enables us to get temperatures otherwise unavailable, so that we can get chemical actions which are impossible at lower temperatures, either because they are endothermic or because the materials do not come into chemical contact at ordinary temperatures. It is impossible to say what our limits are in the electrical furnace. Probably the temperature is limited by the volatilising of carbon. The products are not limited to endothermic compounds; the furnace is useful for the reduction of metals and phosphorus, and for melting glass and, it is hoped, silica for optical and laboratory purposes, and perhaps for cooking utensils and evaporating pans and crucibles in chemical engineering and metallurgy.

Railways.

It is almost absurd to begin to consider the limits of the use of electrical transmission on railways at this date. The future of electric railways, electric tramways and automobiles is rather a matter of vague conjecture and picturesque prophecy. Tubes are multiplying rapidly, and railways are putting down electric transmission on suburban lines in Europe and the States. On short lines with many stops, we have to contend with inefficiency at starting. On long lines, there is difficulty of transmission or cost of transformation and difficulties of collection. We are limited by the want of either a variable speed simple alternate-current motor or a simple variable speed-gear capable of transmitting a very large torque and packing into an engine. A recently developed scheme is the use of low-frequency alternating currents with laminated series-wound motors. This solves the difficulty, but at the expense of large idle current, induced pressure in short-circuited armature coils, large expensive and inefficient transformers, and the ordinary disadvantages of the series-motor on constant pressure. This plan is well worth serious study.

The collection of large currents at great speeds has long loomed as a limit. The published accounts of experiments at Zossen would lead us to suppose there is no trouble on this score. Still, it is a difficulty many engineers fear.

In electric tramways, there is no limit in sight. The power can be sent over any distance desired, and there seems to be no limit to the people who want to travel on electrical trams. The question of electrolysis is rather that of a limit to the duration of pipe companies' property. It is a very difficult question. Though the threatened effects of electrolysis have no doubt been exaggerated, it is at best a question of degree, and the ingenuity of engineers is continually reducing the chance of damage. It has recently been urged that frequent reversals of polarity of the system reduce the electrolysis very considerably.

Electrolysis.

This is a branch of industry in which it is very difficult to tell our limits. In electrolytic copper-refining, our limit is that of the copper wanted. Our electrolytic industries suffer mostly from the limits of intelligence of the investing public. It is assumed that we cannot do electrolysis in England because we have no water power. This is only an excuse for inactivity. As already explained, we can do just as well without water power. A blast furnace is much more valuable than a waterfall of similar power, because it is near coal and in an industrial district. Moreover, as already explained, the cost of electrical energy is a small portion of that of most electrolytic products. At first, electrolysis was to be applied to copper-refining. Then to caustic soda. The output of electrolytic caustic is really rather limited by the demand for bleach. What is urgently wanted is some other way of storing and carrying chlorine. Steel bottles and compression plant are an unsatisfactory solution. What are the limits in the way of electrolysing fused salt They are all incidental limits. The containing vessel is

difficulty. Sodium vapour attacks all silicates. Sodium distils near the temperature of fused salt. If not volatilised, it forms a conducting bridge from the kathode. It attacks iron, though slowly. Hot porcelain and earthenware conduct electrolytically—as, by the way, the maker of electric frying-pans knows—hot chlorine attacks metals, even when dry, and hot carbon cannot be exposed to the air. In addition, sodium and perhaps chlorine are soluble in hot salt, and traces of sulphate in the salt act as carriers. I could a tale unfold if I read out laboratory notes of sodium experiments on a fairly large scale. The difficulties are all incidental, though, and I have little doubt electrolytic sodium at a few pounds per ton will be in the market soon, and will affect profoundly many chemical and metallurgical industries.

In metallurgy, electrolytic solution processes are in use or on trial for the more valuable metals, such as copper and nickel. The reaction between chlorine and metallic sulphides at high temperatures brings the whole domain of sulphide ores under our sway. Thus a sulphide, say galena, is treated with chlorine, which gives off the sulphur as sulphur, which is condensed and sold, making chloride of lead. The silver is extracted by stirring with a little lead, and the fused salt is then electrolysed, yielding pure desilverised lead and chlorine. The process is thus self-contained, yielding sulphur, lead and silver. It is specially applicable to mixed refractory ores which are now nearly valueless and very plentiful, and contain much metal content, such as the mixed lead-zinc sulphides of America or Australia. These reactions have been proved on the large or ton scale, and there is no technical difficulty. Unfortunately, mine people are somewhat ignorant of electrical matters, and it is exceedingly difficult to get them to understand or appreciate a process like this, capable though it may be of paying good dividends on very large capitals indeed.

Our limit in electrolysis in this country is almost entirely human inertia. Commercial and financial people do not understand it, and fight shy of it. But our technical people are nearly as bad. The pure physicist, as a rule, takes no interest in electrolysis or physical chemistry, and thinks it belongs to the chemical classroom on the other side of the passage. The chemist thinks it is higher mathematics and will have none of it, the mathematician thinks it may be an exercise in differential equations; but they are all agreed that it is a sort of continental fungus which flourishes with no roots, and that it is beneath the attention of a scientific man to know enough about it to give a reason for the broad statement that it is all nonsense.

DUTY-FREE ALCOHOL FOR SCIENTIFIC PURPOSES.

TEACHERS of organic chemistry have often expressed the opinion that alcohol used for purposes of education and research should be relieved of the heavy duty levied upon it. Two years ago, attention was directed to the need for action in the matter, and at the Glasgow meeting of the British Association in 1901, a committee was appointed, with instructions to approach the Board of Inland Revenue, with the object of endeavouring to secure the removal of this tax upon scientific work. As the result, the following regulations have been issued by the Board and published in the daily Press:

Regulations for the Use of Duty-free Spirit at Universities, Colleges, &c.

(1) An application must be made by the governing body or their representatives, stating the situation of the particular university, college, or public institution for research or teaching, the number of the laboratories therein, the purpose or purposes to which the spirits are to be applied, the bulk quantity likely to be required in the course of a year, and, if it amounts to fifty gallons or upwards, the name or names of one or more sureties, or a guarantee society to join in a bond that the spirits will be used solely for the purpose requested and at the place specified.

(2) The spirits received at any one institution must only be used in the laboratories of that institution, and must not be distributed for use in the laboratories of any other institution, or used for any other purpose than those authorised.

(3) Only plain British spirits or unsweetened foreign spirits of not less strength than 50 degrees over proof (*i.e.* containing not less than 80 per cent. by weight of absolute alcohol) may be received duty free, and the differential duty must be paid on the foreign spirits.

(4) The spirits must be received under bond either from a distillery or from an Excise or Customs general warehouse and (except with special permission) in quantities of not less than nine bulk gallons at a time. They will be obtainable only on presentation of a requisition signed by the proper supervisor.

(5) On the arrival of the spirits at the institution, the proper Revenue officer should be informed, and the vessels, casks or packages containing them are not to be opened until he has taken an account of the spirits.

(6) The stock of spirits in each institution must be kept under lock in a special compartment under the control of a professor or some responsible officer of the university, college or institution.

(7) The spirits received by the responsible officer of the institution may be distributed by him undiluted to any of the laboratories on the same premises.

(8) No distribution of spirits may be made from the receiving laboratory to other laboratories which are not within the same premises.

(9) A stock book must be provided and kept at the receiving laboratory in which is to be entered on the debit side an account of the bulk and proof gallons of spirits received with the date of receipt, and on the credit side an account of the bulk and proof gallons distributed to other laboratories. A stock book must also be kept at each other laboratory, in which must be entered on the day of receipt an account of the bulk and proof gallons of spirits received from the receiving laboratory.

These books must be open at all times to the inspection of the Revenue officer, and he will be at liberty to make any extract from them which he may consider necessary.

(10) The quantity of spirits in stock at any one time must not exceed half the estimated quantity required in a year where that quantity amounts to twenty gallons or upwards.

(11) Any contravention of the regulations may involve the withdrawal of the Board's authority to use duty-free spirits.

(12) It must be understood that the Board of Inland Revenue reserve to themselves full discretion to withhold permission for the use of duty-free spirit in any case in which the circumstances may not seem to them to be such as to warrant the grant of it.

J. B. MEERS,
Secretary.

Inland Revenue, Somerset House, W.C., November 17.

NOTE.—"Proof Spirit" is defined by law to be such spirit as at the temperature of 51° Fahrenheit shall weigh $\frac{12}{13}$ths of an equal measure of distilled water.

Taking water at 51° Fahrenheit as unity, the specific gravity of "proof spirit" at 51° Fahrenheit is 0·92308. When such spirit is raised to the more usual temperature of 60° Fahrenheit, the specific gravity is 0·91984.

To calculate the quantity of spirits at proof in a given quantity of spirit over or under proof strength:—Multiply the quantity of spirit by the number of degrees of strength of the spirit, and divide the product by 100. The number of degrees of strength of any spirit is 100 *plus* the number of degrees overproof, or *minus* the number of degrees underproof.

EXAMPLE:—19·8 gallons of spirits at 64·5 overproof
$100 + 64{\cdot}5 = 164{\cdot}5$ proof strength.
$164{\cdot}5 \times 19{\cdot}8 \div 100 = 32{\cdot}571$
taken as 32·5 gallons at proof.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—In connection with the School of Geography, Mr. Mackinder will lecture weekly during Hilary term on the historical geography of Europe, Mr. Dickson will lecture on surveying and mapping and on the climatic regions of the globe; he will also give, in conjunction with Mr. Darbishire, practical instruction in military topography; Mr. Herbertson will lecture on the British Isles, the regional geography of continental Europe, and on types of land forms, mountains and coasts; Dr. Grundy will lecture on the historical topography of Greece, and Mr. Beazley on the period of the great discoveries, 1480–1650.

SIR WILLIAM COLLINS has accepted the invitation to stand as the Liberal candidate for London University at the ensuing Parliamentary by-election.

We learn from *Science* that at a recent meeting of the National Academy of Sciences, a grant of eight hundred dollars was made from the income of the J. Lawrence Smith bequest to Dr. O. C. Farrington, of the Field Columbian Museum, Chicago, to enable him to conduct certain investigations upon American meteorites.

Just as in this country there are gratifying signs that teachers in secondary schools are making earnest efforts to acquaint themselves with scientific methods of teaching the subjects of the school curriculum, so in France there is a movement in the same direction. We learn from the *Révue générale des Sciences* that M. Liard, vice-rector of the Académie de Paris, is organising conferences of teachers in secondary schools at which the chief inspectors will explain to French schoolmasters the objects it is desired they shall have in view in their teaching. The first conference was confined to teachers of modern languages and the second was devoted to a consideration of the teaching of physical and natural science.

Another instance of the large scale on which provision is made for every grade of education in America is afforded by the post-graduate medical school that has recently been incorporated in the city of Washington. There are to be, we learn from the *Lancet*, 104 professorships established, as follows:—Six of preventive medicine, two of medical zoology, one of protective inoculation, serum-therapy and biochemistry, two of sanitary chemistry, eight of bacteriology, seven of pathology, fourteen of internal medicine and therapeutics, one of surgical anatomy, fourteen of surgery, six of military medicine and surgery, two of orthopædic surgery, nine of gynæcology, six of obstetrics, three of tropical diseases, four of diseases of children, two of mental and nervous diseases and electrotherapeutics, two of diseases of the stomach, eight of diseases of the eye, eight of diseases of the nose, throat and ear, four of special diseases and four of diseases of the skin.

The examination of the calendars of different University Colleges soon convinces the student of education that every class of society in the city where the college is located must come under its influence. In the case of the University College of Nottingham, for example, we find from the new calendar that for the twenty-second session of the college there are, in addition to lectures for preparing to graduate in the various university faculties, classes for artisans engaged in the engineering, building, and lace and hosiery trades. Students of the same college may be studying subjects so far removed as Greek and plumbing, Anglo-Saxon and pattern-making. While one student is training to become a schoolmaster and is attending lectures on psychology and pedagogics, another hopes to develop into an electrical engineer, and spends his time at electrical measurements in the physical laboratory. In such an institution, it should be impossible for a student to obtain other than a broad, catholic way of regarding the various branches of human knowledge.

It is a pertinent question whether we as a nation are incapable of looking ahead or whether we are too apathetic to provide for future contingencies. On all sides, warning voices proclaim the deficiencies in our educational system, lack of enterprise and antiquated methods. Prof. Bower availed himself of the opportunity afforded when he was delivering his inaugural address before the North British branch of the Pharmaceutical Society to point out how one practical side of botany, the study of vegetable economics, is ignored in this country at the present time. What is required is a well-equipped staff, including specialists in botany, physics, chemistry and physiology, to provide training for students, to institute research and furnish expert advice. Neither at Kew, which, as Prof. Bayley Balfour later expressed it, acts as the clearing-house for the Empire, nor elsewhere is such a staff to be found. The study of vegetable economics might, in Prof. Bower's opinion, be advantageously pursued in commercial centres such as Glasgow, Liverpool and Belfast, and he has laid before the authorities of his University the desirability of appointing a special lecturer in this subject.

On December 3, a conference on "Nature-study" was held with special reference to the development of the work of Stepney Borough Museum with the schools. Mr. J. H. Wylie presided over the meeting, which was held in the Art Gallery, and Canon Barnett, in welcoming the audience, brought forward a suggestion that the winter garden of the People's Palace should be made into a Nature-study centre. Mr. A. D. Hall gave a general address and offered no explanation of the meaning of Nature-study, saying that as most of his audience were teachers that difficulty was removed. He urged that living things should be studied, not collections of dead things in boxes, and suggested the growing of food plants in East-end schools. Bean seedlings, he said, could be measured by the children, who could then make curves illustrating the growth on squared paper. His only allusion to the Museum was in connection with a supposed annual outing of the children, and he suggested that the journey then undertaken might be illustrated in the institution. Prof. Farmer alluded to the help as regards material to be obtained from the Chelsea Physic Garden. The Rev. Claude Hinscliff stated that the object of the conference had been lost sight of, and showed the necessity of opening the eyes of the East-ender by means of the Museum to what he might see when he did go into the country. Mr. F. C. Mills, the chairman of the Museum committee, expressed his pleasure as regards the interest taken in the conference, in spite of the fact that its purpose had been unfulfilled. The School Board inspector for the district alluded to work such as that suggested by Mr. Hall and of an elementary biological nature having been carried on for years at the schools in which he was interested. Mr. Wilfred Mark Webb urged the teachers not to introduce formal and systematic lessons, and Miss Kate Hall, the curator of the Museum, who had organised the conference, spoke of her intentions and requirements.

SOCIETIES AND ACADEMIES.

London.

Royal Society, November 27.—"Descending Intrinsic Spinal Tracts in the Mammalian Cord." By C. S. Sherrington, M.A., M.D., F.R.S., and E. E. Laslett, M.D.Vict.

Experiments inquiring into the existence of spinal paths connecting the activity of segments situate nearer the head with segments lying further from the head.

The method adopted may be termed the method of "*successive degeneration.*" It consists in producing two or more successive degenerations with allowance of a considerable interval of time between them. In the piece of cord to be examined, a first degeneration is allowed time enough to remove all the tracts descending from sources other than those the immediate object of inquiry. When the time is complete, the cord is left, as it were, like a cleaned slate, on which once more a new degeneration can be written without fear of confusion with a previous one. The cord is then ready for receiving the lesion which shall cause degeneration of the particular tracts the existence of which is suspected. After a period suitable for the full development of the new degeneration, the cord is treated histologically by the Marchi method, and the microscopical examination proceeded to.

Results.

The spinal segments examined as sources of aborally-running fibre-systems have been posterior cervical, anterior thoracic, mid thoracic, posterior thoracic and anterior lumbar. From all these regions, the experiments demonstrate that copious aborally-running fibre-systems spring.

Speaking generally, of the fibres composing the aborally-running systems springing from the grey matter of the spinal segments examined, there may be distinguished two sets. For physiological description, it is in some ways convenient to regard the length of the spinal cord as divisible into regions; thus, a brachial for the fore limb, a thoracic for the trunk, a crural for the hind limb, a pelvic for pelvic organs, a caudal for the tail, and so on. A reflex initiated *viâ* an afferent path of one such spinal region may evoke its peripheral effect by efferent paths of a spinal region other than that to which the original entrant path belongs. Such a reflex has in a former paper by one of us [1] been termed a "long" spinal reflex, in contradistinction to reflexes the centripetal and centrifugal paths of which both belong to one and the same spinal region. The latter reflex it was proposed to term "short." [2] Analogously, in the aborally-running fibre-systems of the spinal segments examined, by our experiments fibres of two categories are found, one a set passing beyond the limits of the spinal region in which they arise, the other not passing beyond those

[1] C. S. Sherrington, "Croonian Lecture," *Phil. Trans.*, 1897.
[2] *Ibid.*

limits. The former we would term "long spinal," the latter "short spinal" fibres. In each of these main categories, there can be distinguished fibres of various intermediate length.

Again, the fibres of each of the above two categories may be classified into two sets or tracts, according to their topography relatively to the cross-section of the cord. Fibres of both of the above categories are situate both in the lateral columns and in the ventral columns of the cord. It is useful, at least for descriptive purposes, to indicate this by terminology. We thus recognise in the aborally-running intrinsic spinal fibre systems the following sets or tracts:—(α) *Ventral short fibres*, (β) *Ventral long fibres*, (γ) *lateral short fibres*, (δ) *lateral long fibres*. It must be added that the distinction into lateral and ventral is somewhat artificial, as there exists often, especially in the case of the "short" fibres, no distinct gap between the ventral and lateral fields of distribution of the fibres in the transverse area of the cord.

The paper concludes with an analysis of evidence as to decussation of the long and short fibres.

December 11.—"Quaternions and Projective Geometry." By Prof. Charles J. Joly, F.T.C.D., Royal Astronomer of Ireland. Communicated by Sir Robert S. Ball, F.R.S.

The object of this paper is to include projective geometry within the scope of quaternions.

Chemical Society, December 4.—Dr. W. H. Perkin, F.R.S., vice-president, in the chair.—The following papers were read:—The specific heats of liquids, by Mr. H. Crompton. When heat is applied to an unassociated liquid, there is an increase in molecular kinetic energy, internal work is done within each molecule, intermolecular attraction is diminished and a small amount of external work is done. The first two factors together make up the specific heat at constant volume. The evaluation of the diminution of intermolecular attraction is made by the author on the assumption that the total attraction is equal to the difference between the latent heat of vaporisation and the heat evolved when the vapour is compressed to the volume it would occupy as a liquid but without undergoing this change of state. Assuming that this attraction is zero at the critical point and increases regularly with decrease of temperature, its change with temperature is given by the expression $(L - RT \log V/v)/(T_k - T)$, where L is the latent heat, T_k and T the absolute critical temperature and absolute temperature respectively, V and v the volumes of the vapour and liquid respectively. Neglecting the fourth factor, viz., the external work done, the author shows that the molecular heats of various liquids for which the foregoing data are available agree fairly well with those calculated by this method.—The constitution of enolic benzoylcamphor, by Dr. M. O. Forster. It is shown that this substance is probably phenylhydroxymethylenecamphor from a consideration of the derivatives and decomposition products obtained from it.—Isomeric benzoyl derivatives from isonitrosocamphor, by Dr. M. O. Forster. Two isomerides have been obtained; one crystallises in yellow prisms and melts at 105°; the other is colourless, melts at 136° and does not give isonitrosocamphor on hydrolysis.—Action of phosphorus haloids on dihydroresorcins, by Drs. Crossley and Le Sueur.—The absorption spectra of metallic nitrates, ii., by Prof. Hartley. The positions of the characteristic absorption bands depend upon the molecular weights of the salts in solution. The characters of the spectra observed are equally well explained by the assumption that *partial* ionic or *partial* hydrolytic dissociation occurs on solution.—The constitution of the products of nitration of *m*-acetoluidide, by Dr. J. B. Cohen and H. D. Dakin.—The action of metallic thiocyanates upon carbonyl chloride, by Dr. A. E. Dixon. A description of the substituted thiocarbimides obtained.

Entomological Society, November 19.—The Rev. Canon Fowler, president, in the chair.—Dr. Sharp, F.R.S., exhibited the egg-cases made by a beetle of the genus Aspidomorpha (*A. puncticosta*), and stated that they had been sent to him by Mr. F. Muir, of Durban, Natal, where the beetle and the egg-cases are common.—Dr. Norman H. Joy exhibited a well-marked aberration of a female *Lycaena icarus* striped black on the underside in the place of the usual ocellations; a gynandromorphous specimen of the same species; an aberration of a male *Lycaena bellargus*, similarly striped on the underside; a specimen of *Everes argiades* taken in 1885 at Bournemouth; and specimens of *Apatura iris* from the neighbourhood of Reading, taken from what appeared to be the throne of the ruling "Emperor" of the wood. Whenever another iris came by, the one on the "throne" attacked it, and after a fight, in which one would eventually pursue the other out of sight, the victor returned to the perch. If this was captured, the next *iris* coming along would take possession, and so on.—Mr. Claude Morley exhibited a specimen of *Diastictus vulneratus*, Sturm., new to Great Britain, and a rare blue form of *Miratora vitellinae* from Tuddenham Fen.—Mr. G. C. Champion exhibited specimens of *Nanophyges duricuri*, Lucas, a beetle from Central Spain, with drawings of the larva, pupa and perfect insect.—Prof. E. B. Poulton, F.R.S., stated that Mr. A. H. Church, of Jesus College, Oxford, had observed the larvæ of a species of Cucullia (probably *C. verbasci*), feeding upon *Buddleia globosa* which was growing against a wall in the Oxford Botanical Gardens. It is possible that the eggs were laid upon the Buddleia because of the very rough general resemblance in certain respects between its leaves and those of Verbascum. Mr. R. McLachlan, F.R.S., mentioned the case of *Mamestra persicariae*, at Lewisham, choosing *Anemone japonica*. He had offered them fern and elder (which is reputed a favourite food), but the larvæ refused everything except the original anemone. Mr. Goss said that larvæ of *Choerocampa elpenor*, taken at Weybridge from a species of American balsam, afterwards refused willow herb, the usual food-plant of the species. Prof. Poulton read a communication from Mr. G. F. Leigh relating to the enemies of Lepidoptera in Natal. The very common grey South African rat seems to be particularly fond of almost any pupæ, and will gnaw through thick wooden boxes to get at them. They affect especially *Choerocampa eson* and *C. nerii*. Even more remarkable than their keenness in hunting pupæ is the way in which they capture moths on the wing when feeding. Whilst flying at dusk, a rat would leap from the roof right on to their food-plant, and more often than not the moth selected for attack was captured. Bats are also very destructive of South African insect-life.

Ray Society, December 11.—Council Meeting.—Mr. John Hopkinson, treasurer, in the chair.—A vote of condolence with the widow and family of the late secretary of the Society, the Rev. Dr. Wiltshire, was passed, and in his place Mr. Hopkinson was elected secretary. The question of the appointment of treasurer was not finally decided.

MANCHESTER.

Literary and Philosophical Society, December 2.—Mr. Charles Bailey, president, in the chair.—Mr. C. L. Barnes showed a number of experiments depending on Hawksbee's law, viz., that the pressure on the walls of a tube containing a fluid is less when the fluid is in motion than when it is at rest. Several of these are well known, *e.g.*, the apparent attraction which results when a current of air, radial or other, passes between two parallel discs, and the suspension of a ball on a jet of air or water. Other illustrations of the principle are that it is impossible to blow a celluloid ball, or even an inflated toy balloon, out of a funnel held in the ordinary upright position, though, if the funnel be reversed, the ball or balloon can be supported without difficulty. Also, if a couple of celluloid balls are placed on a kind of railway made by fastening two rods to one another, they cannot be separated by blowing between them. The experiment of forcing a celluloid ball out of a tall glass cylinder by blowing downwards upon it was also performed, as were also several others of a similar character.—Mr. Frank Southern exhibited and described a Japanese magic mirror, and Dr. C. H. Lees showed a small piece of apparatus used in the determination of the thermal conductivities of solids over wide ranges of temperature. It consists in principle of a differential hydrogen thermometer, one bulb of which is heated by an electric current either in a flat strip of metal wound round it or passing through the material of the bulb itself.

DUBLIN.

Royal Dublin Society, November 18.—Prof. D. J. Cunningham, F.R.S., in the chair.—Prof. T. Johnson read a paper on *Phellomyces sclerotiophorus*, Frank, a fungus of unknown affinities which causes a form of scab in potato-tubers and, in extreme cases, a dry rot. The author first observed the fungus in several potato varieties, grown in the west and other parts of Ireland, in the autumn of 1901.—Phellomyces causes the formation of discoloured patches in the skin of the

tuber, in the midst of which are generally present the minute sclerotia, 0·1 mm. in diameter, just recognisable, in washed tubers, with the naked eye. In mild attacks, the fungus simply makes the tuber unsightly; in more severe cases, it strips off layer after layer of the protecting skin of the tuber, and may ultimately penetrate through the skin into the flesh of the tuber, killing the protoplasm, sending the mycelial hyphæ between and through the cells, and boring into the starch grains. Both in appearance and action, Phellomyces is readily distinguishable from Rhizoctonia, an extremely common cause of scab and rot in potatoes. Phellomyces can pass from seed tubers to the resulting crop, and is communicable from infected ground to healthy tubers grown in it. The author found soaking the diseased tubers in 0·8 per cent. solution of formalin for 1½ hours destroyed the fungus, untreated diseased tubers giving, under otherwise similar conditions, a diseased crop. Three varieties imported from France, planted in Connemara, gave crops showing *Sclerotinia sclerotiorum* and *Phellomyces sclerotiophorus*, both unknown in France on the potato up to the present time. Frank first saw the fungus, in various parts of Germany, in 1894, and again in succeeding years. The author said he had nothing to add to the account given by Frank of its very imperfectly known life-history.—Mr. Leonard Murphy read a paper on a new method of determining the amount of liquid in distant and inaccessible tanks, &c.—Mr. G. H. Carpenter exhibited lantern slides of insects (Collembola) taken in Mitchelstown and Dunmore caves in the south of Ireland, pointing out that while some of the species seemed to be confined to such localities and to represent special modifications for life in caves, others were identical with insects found in the upper world with a discontinuous range, and must be regarded as the survivors of very old races.

EDINBURGH.

Royal Society, November 3.—The Hon. Lord M'Laren, vice-president, in the chair.—The chairman in his opening remarks made special reference to the publication of the Ben Nevis observations, the first volume of which had just been issued. Half the expense of these publications, which would fill three volumes of the *Transactions*, was being borne by the Royal Society of London. Another matter of special interest was the systematic bathymetrical survey of the Scottish lakes which had been organised by Sir John Murray and Mr. Laurence Pullar. During the seven months beginning March last, they had surveyed 153 lochs and taken nearly 24,000 soundings. The greatest depth observed was in Loch Morar, 1009 feet, which exceeds by several hundred feet the depth recorded in any other lake in the British Islands. In addition to the routine work of taking soundings and determining heights, observations of temperature and of "seiches" and collections of plankton and bottom deposits were made by the staff. The results were now being prepared for publication in Edinburgh, and preliminary papers dealing with the work would from time to time be laid before the Society.—Sir William Turner communicated a paper entitled "Contributions to the Craniology of the People of Scotland." The material had been collecting for many years in his hand, and in this first paper he gave the detailed results of the measurement of nearly 200 skulls obtained from all parts of Scotland. Of these, 28 per cent. were dolichocephalic, 20 per cent. brachycephalic, and 52 per cent. belonged to the intermediate group. As regards their distribution, the brachycephalic type was characteristic of Fife, the Lothians, the eastern counties between the Tay and the Moray Firth, and Shetland; whilst the dolichocephalic type was most prevalent in Renfrewshire, Wigtonshire, Caithness and the Highlands. A very marked percentage of the brachycephalic skulls had distinct frontal sutures, a very unusual feature in adult skulls. This indicated growth in breadth during adult life. The skulls were capacious and somewhat above the average for western Europe. As regards the facial characters, the orbits were wide and circular and the noses long and narrow. The discussion of the ethnographical bearing of the facts was reserved for a second paper.—In a paper on the electrical conductivities and relative densities of certain samples of sea-water, Mr. J. J. Manley described some novelties of method in the accurate measurement of these quantities. The results were negative, there being no discoverable relation between the conductivities and densities.—Two papers by Dr. Thomas Muir on generating functions of certain determinants were also presented.

November 17.—The Rev. Prof. Duns in the chair.—Dr. W. G. Aitchison Robertson read a paper on the local distribution of cancer in Scotland. In collecting his material, he had visited many of the larger institutions and infirmaries throughout Scotland, and from careful inspection of the registers had, as far as possible, allocated the various cases to their proper counties. In this respect, he believed that his statistics were more accurate than those derived directly from the reports of the Registrar-General, for it was quite evident that many of the cases recorded as having occurred in the larger towns really belonged to neighbouring or even remote country districts. His corrections made important changes in the chart of distribution. Thus, when corrected for the presence of strangers, the cancer mortality for the city of Edinburgh fell from 5·15 per cent. (as it appeared to be from the Registrar-General's returns) to 4·13 per cent., which is practically the normal for the whole of Scotland. On the other hand, by the same correction the cancer mortality for the county of Edinburgh increased to nearly 5 per cent. On the whole, the mainland rural districts and smaller towns had a higher cancer mortality than the large towns and cities. In the county of Nairn, the mortality was 9·73 per cent. In the outer Hebrides, the mortality was distinctly below the normal for Scotland. The statistics showed many curious features, and it was utterly impossible to connect the distribution with climatic or geologic conditions, or with race or food supply. That the towns were healthier than the rural districts seemed to dispose of several of the ordinary theories as to the undoubted increase of the disease within the last half-century. This could be regarded as only a first effort to get at information regarding local distribution of cancer, and Dr. Robertson urged upon the medical profession in Scotland the importance of a combined investigation of the causal relations of this dread disease.—Mr. J. Ross communicated a short note on the trisection of an angle, and a paper by Dr. Thomas Muir on pure periodic continued fractions was also read.

PARIS.

Academy of Sciences, December 8.—M. Bouquet de la Grye in the chair.—The president announced to the Academy the death of two members, M. Dehérain, member of the section of Rural Economy, and M. Hautefeuille, member of the section of Mineralogy.—On the transformation of the diamond into black carbon during its oxidation, and on the isomeric changes of simple bodies during decompositions and combinations, by M. Berthelot. Some remarks on work recently published by M. Moissan.—On the irreducibility of the equation $y'' = 6y^2 + x$, by M. Paul Painlevé.—On the quantity of free hydrogen in the air and the density of atmospheric nitrogen, by M. Armand Gautier. Four years ago, the author published work proving the existence of free hydrogen and methane in the air, and estimated their quantity. The proportion of hydrogen then found has been questioned by Lord Rayleigh, and M. A. Leduc has recently adduced other evidence in confirmation of Lord Rayleigh's objections. It is shown that the exact concordance between the percentage of oxygen by weight found by M. Leduc and the value calculated from the densities of the gases is accidental, and that the results are quite consistent with the presence of the amounts of hydrogen and methane found by the author.—On the development of the Peripatidæ of South Africa, by M. L. Bouvier.—On some Hæmogregarians of Ophidians, by M. A. Laveran.—The internal action of copper sulphate in the resistance of the potato to *Phytophthora infestans*, by M. Emile Laurent. The experiments described led to the conclusion that potato tubers should be immunised against this fungus by dipping them for a certain time in a solution of copper sulphate, but on actual trial it was found that potatoes so treated and then purposely infected with the Phytophthora were attacked as vigorously by the parasite as the untreated tubers.—Observations of the new comet Giacobini (*d* 1902), made at the Observatory of Paris, by MM. G. Bigourdan, G. Fayet and P. Salst. On December 6, the comet was a nebulosity of magnitude 13·2, diffuse, vaguely rounded and of 30" diameter.—Provisional elements of the Giacobini comet, by M. G. Fayet.—On the properties of the plane from the point of view of the *Analysis situs*, by M. Combebiac.—On a summatory form in the theory of functions of two variables, by M. Martin Krause.—

On a dark chamber for three-colour photography, by M. Prieur. The problem to be solved was to devise a mechanism which, on closing the shutter, would remove the exposed plate and at the same time replace it by the succeeding plate, placing the latter accurately in the focus of the objective. This problem has been satisfactorily solved.—On bipolar electrodes with a soluble anode, by MM. André Brochet and C. L. Barillet. In an electrolytic cell containing a solution of copper sulphate, the interposition of an insulated copper plate gives results very similar to those previously described with a platinum plate. It was not found possible to predict the phenomenon in any given case.—On thallic chloride, by M. V. Thomas. The chloride $TlCl_3, 4H_2O$ can be dehydrated in a vacuum without any loss of chlorine. The properties of the anhydrous chloride are given.—On Gmelin's violet manganese metaphosphate, by M. Ph. Barbier.—Addition derivatives from cyclohexene, by M. L. Brunel.—On a dichlorhydrate and dibromhydrate of cadinene and on a dextrorotatory regenerated cadinene, by M. Emilien Grimal.—On the essence of vetiver, by MM. P. Genvresse and G. Langlois. This essence contains a sesquiterpene, a sesquiterpene alcohol, and an ester to which the odour is due.—On the excretion and variation of the kidney in carnivorous fowls of the second generation, by M. Frédéric Houssay.—The formation of chlorophyll in rarefied air and in rarefied oxygen, by M. Jean Friedel. In air expanded to one-sixth of the atmospheric pressure, the leaves of Phaseolus are almost entirely etiolated; in oxygen at the same pressure, the leaves are coloured as in ordinary air. It would thus appear that the relative pressure of the oxygen is the predominating factor, the total pressure having no sensible influence.—On some new fossil infusoria, by M. B. Renault.—On the immunisation of the lettuce against the fungus *Bremia Lactucae*, by M. E. Marchal. By treatment with solutions of copper sulphate of certain strength, it was found possible to prevent the growth of the parasite from interfering with the growth of the plant. The narrow margin, however, between the immunising dose of copper sulphate and that capable of acting injuriously on the lettuce plant renders the practical application of these results difficult.—Some mineralogical observations made on the products from the burning of St. Pierre, Martinique, by M. A. Lacroix.—On the Palæozoic earths of Oued Saoura and Gourara, by M. E. F. Gautier.—On economic appreciation and improvements due to cultivation, by M. E. Rabaté.—On the application of chemical manures to the cultivation of the vine in the calcareous earths of Charentes, by MM. J. M. Guillon and G. Gouirand.—On some exotic Graminaceæ employed in food, by M. Balland.—On some brilliant red sunsets observed at Athens during the months of October and November, 1902, by M. D. Eginitis.

New South Wales.

Linnean Society, October 29.—Mr. J. H. Maiden, president, in the chair.—On two remarkable Sporocysts occurring in *Mytilus latus*, on the coast of New Zealand, by Prof. W. A. Haswell, F.R.S.—(1) On *Eucalyptus polyanthemos*, Schauer; (2) on *E. bicolor*, A. Cunn, by Mr. J. H. Maiden. The author quotes the original descriptions of the species, cites their synonyms, discusses their affinities and gives an account of their range.—Contributions to a knowledge of the Australian flora, part iv., by Mr. R. T. Baker. A number of new localities for species are recorded, thus extending their known geographical range.—Notes on the botany of the interior of New South Wales, part vii., by Mr. R. H. Cambage. The conspicuous vegetation of the country between Forbes and Bathurst is described.—On the mammalian and reptilian vomerine bones, by Dr. R. Broom. The author shows that in the early stages of development the nasal capsules of the lizard and marsupial are essentially similar in structure and that in both a well-developed paraseptal cartilage runs by the base of the septum from the nasal floor cartilage in front to the hinder part of the capsule. He also shows that the so-called "vomer" in the lizard develops in connection with this cartilage; and as the dumbbell-shaped bone in Ornithorhynchus and the median bone of Miniopterus also develop as splints to the paraseptal cartilages (specialised as cartilages of Jacobson), he concludes that these mammalian bones are homologous with the so-called "vomers" of the lizard and are therefore really *prevomers*.

DIARY OF SOCIETIES.

THURSDAY, December 18.

Linnean Society, at 8.—Notes on Copepoda from the Faeroe Channel: Thos. Scott.—Amphipoda of the *Southern Cross* Antarctic Expedition; Alfred O. Walker.—The Deep-Sea Isopod *Anurus branchiatus*, Bedd.: Dr. H. J. Hansen.

Institution of Electrical Engineers, at 8.—Notes of Recent Electrical Designs: W. B. Esson.

FRIDAY, December 19.

Institution of Civil Engineers, at 8.—Electricity Supply from Double Current-Generators: P. R. Wray.

Institution of Mechanical Engineers, at 8.—Recent Practice in the Design, Construction and Operation of Raw Cane Sugar Factories in the Hawaiian Islands: J. N. S. Williams.

TUESDAY, December 23.

Institution of Civil Engineers, at 8.—*Paper to be further discussed*:—The Rupnarayan Bridge, Bengal-Nagpur Railway: S. Martin-Leake.—*Paper to be read*:—Electric Automobiles: H. F. Joel.

CONTENTS.

THURSDAY, DECEMBER 25, 1902.

AGRICULTURAL SCIENCE IN ITALY.

Chimica Agraria, Campestre e Silvano. Di Italo Giglioli. Pp. xviii + 877; with 31 figures in the text. (Naples: Marghieri, 1902.)

THIS book, the work of the well-known professor of agricultural chemistry in the College at Portici, was originally projected as a treatise on agricultural chemistry, to be followed by other volumes dealing with fermentation and animal chemistry. Written, as the author tells us, with many interruptions, between 1884 and the current year, it remains but a fragment of the original scheme, for it deals only with the relations of the plant to water and to solar light and heat—questions, indeed, of fundamental importance to the agriculture of a semi-arid country like Italy. With nearly 900 pages devoted to so small a section of the subject, it will easily be imagined how vast is the scale upon which the work was planned, and this arouses a question which struck us repeatedly during the perusal of the book. Given a treatise on a technical branch of science, like agricultural chemistry, how far should the author deem it his duty to enter into a complete discussion of whatever branch of the pure science he may require to use for the explanation of some technical problem? For example, we have in the book before us some ten pages, 628–638, given up to an acconnt of the nature of exothermic and endothermic chemical reactions. Now, though it is impossible to understand the problems presented by carbon assimilation under the action of light without possessing the conception of the transfer of energy accompanying a reaction and the reversibility of the change, we hold that the reader of a book like the present will have either reached already the required knowledge of pure chemistry or else must be introduced to the new idea in a much less academic fashion. In the main, a book of this type is written for the expert and should stick very close to its text, taking something more than the elements of the pure sciences for granted.

But it is precisely in this direction that Prof. Giglioli's weakness lies, with the result that the book is cumbered and inordinately expanded with irrelevant matter, interesting enough, but not really bearing upon the point. For example, all kinds of light waves and ethereal radiations doubtless possess some action upon the living plant, but as these effects are still practically unknown, it is surely superfluous to devote fifty pages to a purely text-book account of phosphorescence and kindred phenomena, including the incandescent properties of the rare earths in the Auer lamp, Crookes's tubes, radiant matter and kathode rays; nor, again, in another section, can we see the appropriateness of a discussion of the skin vision of animals or of Prof. Poulton's experiments on the influence of coloured lights upon the larvæ of *Pieris*.

This is the most unsatisfactory portion of the book, and we cannot help feeling that, in his desire to be exhaustive, Prof. Giglioli has discharged upon us pell-mell all the references he has accumulated, without considering how far they have yet been made to bear upon his subject. It is true that the man of science who wants to go beneath the surface of things must carry in his mind all sorts of cognate facts and investigations, in the hope that some day they may supply a missing link in his own work, but he should not present the public with this raw material.

The earlier sections of the book, dealing with the relations of the plant to water, are less academic, and contain many interesting references to the author's own experiences of agriculture under the hot suns and small precipitation of Italy. He discusses at some length the development of the root, and refers to this cause the increased power of resisting drought which certain manures, particularly nitrate of soda, give to the crop. In this section, Prof. Giglioli draws freely on the results of the Rothamsted experiments, particularly on Lawes and Gilbert's paper upon the drought of 1870 and its effect upon the variously manured grass plots. This question of the action of manures upon root development is worthy of more study than it has hitherto received, for it seems to afford a clue to the explanation of the greater ease with which a plant manured with nitrate of soda will in some cases obtain its other mineral food from the soil, as compared with one receiving the same amount of nitrogen in the form of ammonium salts.

The earlier chapters of the book have not been brought so closely up to date as the later pages; in the account of the amount of water transpired by plants, we have Lawes and Gilbert's figures, but not the later work of Hellriegel, Wollny, and King of Wisconsin, and again, in the discussion of the value of tillage in conserving soil moisture, no mention is made of the valuable observations which have been accumulated in America on this point.

The reader who is interested in the effect of climate upon crop production will find that Prof. Giglioli deals repeatedly with this most intricate problem. The alteration by climate of English varieties of wheat introduced into Italy is discussed on pp. 187 and 379, a subject of interest at the present time, when efforts are being made to get into English wheats something of the "strong" character of those imported from more arid countries, and again, on p. 189, we have a correlation of the hay crops grown at Rothamsted under various systems of manuring with the rainfall of the months of April, May and June.

On p. 100, we have a reference to Frank's discovery of mycorhiza, but we have no account of the weighty generalisations contained in the later papers of Frank and of Stahl, which have shown how interesting and widespread a variant of the general course of nutrition is presented by plants with mycorhiza.

The special value of the book lies in its enthusiasm and breadth of view; we feel we are dealing, not only with a specialist, but also with one who possesses a many-sided knowledge and experience. To an Englishman, it is pleasant to see how references to English work abound; particularly it is clear that Prof. Giglioli has kept himself familiar with the experiments at Rothamsted, where so much of the pioneer work in agricultural science has been done. Prof. Giglioli contrasts Italy unfavourably in the matter of agricultural experiments, but will the English work play so large a part in any treatise of a foreign professor fifty years hence? Rothamsted stands where

it did, the monument of two great men's work, but unconnected with any organisation, either official or educational; other countries have been only too anxious to foster and develop any living starting point they could find. A. D. H.

A HIMALAYAN LOCAL FLORA.

Flora Simlensis: a Handbook of the Flowering Plants of Simla and the Neighbourhood. By the late Colonel Sir H. Collett, K.C.B., F.L.S. Pp. lxviii + 652. (Calcutta and Simla: Thacker, Spink and Co.; London: W. Thacker and Co., 1902.)

WHEN, in 1897, Sir Joseph Hooker wrote his preface to the final volume of the "Flora of British India," he gave it as one of the chief uses of his great work that it would "facilitate the compilation of local Indian floras." We believe that since that book began to issue, the handbook before us is the first general local flora that has been prepared for India, though various floras for *forest* purposes only have already appeared. Other general floras, for what are wider areas, are in course of preparation for Bengal, Bombay and the Upper Gangetic Plain; but although these floras will apply to whole provinces, or at any rate to areas as large as provinces, they will, none of them, cover so wide a vertical range, for the late Sir H. Collett's handbook practically treats of plants growing at all altitudes, from the Himalayan valleys only a little raised above sea-level to elevations of 12,000 and even of 16,000 feet. The area taken up is not one of exact geographical limits, but, as the author has said:—

"I have assigned no strictly defined limits to the 'Flora,' believing that this would answer the requirements of students better than if I were to confine it, for instance, to the territorial limits of the Simla Municipality or any other arbitrarily fixed boundaries."

It seems, however, to include every plant which a Simla botanist is likely to meet with in his rambles, and we feel sure that the book will be much appreciated, though we cannot avoid a feeling of great regret that its author has not lived to enjoy the pleasure he looked forward to of knowing that he had done something to help those who are already students of his favourite science, and perhaps to induce more of those Indian officers who want a pursuit to occupy their leisure time, to follow in his footsteps and study the plants of the forests, glens and slopes of the Simla mountains.

It has not been an uncommon thing at Simla to hear the wish expressed that someone would publish a handbook of a not too difficult scientific character, giving the names and descriptions of the chief plants; and, as the author has explained in his preface, it was with the desire of supplying this want that he commenced his work. A careful examination of the book shows that his efforts have been successful. The descriptions are concise and couched in the simplest language; the analyses lead easily to the genus and species required; while the excellent pen and ink drawings prepared by Miss M. Smith, of Kew, will be a great additional help to those who consult the work. These drawings have been judiciously selected, to illustrate, not only the chief genera and species, but also the most common and conspicuous plants to be met with in Simla and its neighbourhood.

In addition to the characters of the natural orders, genera and species, and to analyses and an account of the geographical distribution of the plants, many useful notes are given which are sure to be of interest. As a sample may be cited the brief account of the method of fertilisation of Roscoea, a genus of gingers with purple flowers, where the mechanism by which the anthers are caused to shed their pollen on the backs of the insects which visit them is shown to be similar to that of the quite different genus Salvia in Labiatæ. The derivations of the generic names have been duly explained, and wherever it has seemed of interest, reference has been made to such books as Darwin's "Origin of Species," Fritz Müller's "Fertilisation of Flowers" and Kerner's "Natural History of Plants." It is clear that Sir Henry Collett took the greatest pains to make his book as useful as possible, and it is well that the pioneer of Indian local floras will be such an excellent model for future work of the kind. To the author, as every page of his book shows, his work must indeed have been a labour of love. It will be useful to residents and visitors, not only in Simla, but in the other hill resorts in the Punjab, while even in the more easterly ones—Chakrata, Mussooree, Naini-Tál—where the flora is richer, the book will be of considerable help to those interested in plants.

Besides Sir H. Collett's own preface, the descriptive portion of the work is preceded by an "In Memoriam" notice of the author by Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S., the Director of Kew, and by an "Introduction" by Mr. W. B. Hemsley, F.R.S., the curator of the herbarium at the Royal Gardens. In his notice, Sir W. T. Thiselton-Dyer gives a brief account of the life of the author, who, during a long and distinguished career as a soldier, studied science, and especially botany, in his leisure moments, and after his retirement in 1893 commenced the present work, which he only just lived to complete. Sir William finishes his notice by saying:—

"No one who has ever come to work among us at Kew has more completely won the affectionate regard of everyone with whom he has come in contact."

In his "Introduction," Mr. Hemsley gives a brief account of the geography of Simla, of its vegetation and of the chief botanists whose collections have been utilised in the preparation of the handbook. Some idea of the extent of the flora of the small Himalayan area to which it refers is obtainable from the fact that the handbook describes no less than 1326 species belonging to 639 genera and 113 natural orders.

We may conclude this brief account of a noteworthy botanical handbook with the following extract from the address of the president at the anniversary meeting of the Linnean Society on May 24 last:—

"In Sir Henry Collett we lose an accomplished botanist who was also a gallant soldier and a capable administrator, a combination of qualities that seems to be peculiarly British. It would not be easy to estimate how much this Society, and other kindred societies, owe to the public services, and more particularly the Indian, for the invaluable recruits whom we continually draw from their ranks."

We can hope that the "Flora Simlensis" will prove as enduring a memorial of its author as the record of his achievements, military and administrative, is likely to be in the history of the Indian Empire. J. S. G.

OSTWALD'S INORGANIC CHEMISTRY.

The Principles of Inorganic Chemistry. By Wilhelm Ostwald. Translated by Alexander Findlay. Pp. xxvii + 785. (London: Macmillan and Co., Ltd.) Price 18*s*. net.

VIEWS differ regarding the best method of presenting the facts and theories of chemistry to a beginner. Prof. Ostwald takes the view that "if the present-day chemistry makes greater demands on the power of rational thinking, it also renders the purely memory work of mastering the subject considerably more easy for the student. The growth of the scientific interpretation and elucidation of the separate facts of chemistry facilitates in the highest degree the impression of them on the mind and their application, and at the same time affords an incomparably greater intellectual enjoyment than the study of the older, essentially descriptive, chemistry could offer." Acting on this opinion, Ostwald has introduced physical theories, applicable to chemical facts, "in his stride," as it were. Beginning with some simple metaphysical statements, he develops the fundamental laws of classification and treats of homogeneous substances, mixtures and solutions; he next proceeds to consider the law of the conservation of weight and mass, and of work and energy, treating incidentally of the units in which these magnitudes are measured. The next chapter is devoted to "combustion," the existence of oxygen and the constancy of proportions; and the next to a rapid survey of the elements and their properties. The subsequent treatment is, in a restricted sense, systematic; the remaining chapters treat of oxygen, ozone, hydrogen, water, hydrogen peroxide, chlorine and hydrochloric acid, oxides of chlorine; bromine, iodine and fluorine, sulphur and its compounds, and, in short, the elements generally termed non-metals and their compounds; the metals and their salts complete the list.

But the discursive nature of treating the subject may be gauged by the amount of space—92 pages—devoted to the consideration of oxygen, hydrogen and water. Under the heading "Oxygen," not merely are the preparation and properties of the element considered, but also velocity of combustion, the influence of temperature on that rate, Boyle's and Gay-Lussac's laws, the temperature scales, degrees of freedom of a gas, the construction of curves, the liquefaction of gases, the solubility of gases, and ozone; the condition of allotropy is also shortly discussed. Under "Hydrogen" come methods of drying gases, molecular weights (here termed "molar" weights), the compressibility of gases at high pressures, diffusion, the law of partial pressures, the law of effusion of gases and spectrum analysis; also, *à propos* of the combustion of hydrogen, the law of mass action, chemical equilibrium and the influence of solid substances thereon; and lastly, catalysis, introduced by the catalytic action of platinum in causing combination between oxygen and hydrogen. Under the heading "Water," we find the law of continuity, graphic interpolation, coefficient of expansion, degrees of freedom of liquids, supercooling, heats of fusion, heat-units, vapour-pressures, heats of vaporisation, supercooled vapours, phases of water, ice and steam, and the triple point; next water as a solvent, and the relations between lowering of freezing point and depression of vapour pressure caused by salts; volume relation of gases, "combining" weights, symbols and formulæ, equations, and the atomic and molecular hypotheses.

Now Prof. Ostwald's style is excellent, and full justice is done to it by Dr. Findlay's translation; hence the book is most readable and interesting; the theoretical disquisitions are most clearly stated and arranged in an orderly manner, each point being taken up when its turn has come, but the reviewer doubts whether a beginner would gain much from a perusal of the book. For a teacher who is already familiar with the facts of chemistry, innumerable hints are to be found, almost on every page. But after all, the young chemical student has to familiarise himself with the facts of chemistry, and gilding the pill, even with fine gold, is apt to interfere with its assimilation. For a man of advanced years, even though he be no chemist, who can appreciate the logical arrangement of the book, much enjoyment may be obtained from it; but from long experience of the powers of mind of junior students, the reviewer doubts whether more than two or three specially gifted individuals out of a large class would retain much in their memories.

Just as in learning a language it is absolutely necessary to acquire the common verbs, prepositions and adverbs by heart, and to have at least some idea of the syntax before analytically parsing the sentences, attending to every subtlety, so with chemistry. A large number of facts and their experimental demonstration must become familiar, and it is then time to build up laws on these facts.

However, as stated at the outset, there are many methods of presenting such facts; and if the young student has energy to follow two or three methods of presentment, he will be a gainer. It appears to the reviewer that it would be better to reserve this method of considering the subject until a year, or perhaps more, has been spent in the more usual course of study. The effect of reading such a book at that stage is sure to be most stimulating, and will enable the reader, not only to revise his knowledge, but to enrich it by many necessary additions.

It is unnecessary to mention that the work is entirely up to date, and that the translator, as an old pupil and friend of the author, has completely entered into the spirit of the matter; he has left no trace of its German origin in the excellent English of which he is a master.

W. R.

A NEW THEORY OF THE UNIVERSE.

On an Inversion of Ideas as to the Structure of the Universe. By Prof. Osborne Reynolds, F.R.S. Pp. 44. (Cambridge: University Press, 1902.) Price 1*s*. 6*d*. net.

THIS is a short description of a new theory of the universe which formed the subject of the Rede lecture last June. All such theories must satisfy two conditions. The structure must be dynamically possible, and the results deduced by dynamical reasoning from the

theory must correspond qualitatively and quantitatively to the phenomena of Nature. The analytical difficulties may be too great to deduce all the phenomena, but if any be contrary to experience, the theory, at least in its exact form, must go. It is only by inventing, discussing, comparing and remodelling as many theories as possible that we can hope to arrive at any knowledge of the constitution of matter or of the æther. This new and very original attempt is therefore to be welcomed. As a rule, authors of such theories are satisfied to show how many facts their theory explains, and how probable, therefore, it is that their theory corresponds to reality. Not so, however, Prof. Osborne Reynolds. He claims to have shown that "the research has revealed the prime cause of the physical properties of matter," and that

"there is one, and only one, conceivable purely mechanical system capable of accounting for the physical evidence as we know it in the universe."

That a theory coming from Prof. Reynolds will fulfil the first of our conditions goes without saying. But that it should be possible to give a proof that it *is* the representation of the actual structure of æther and matter is too astonishing to be received without scepticism. We await the publication of the full research.

It is not possible to criticise a complete theory on a short statement of its results—a statement which by its very nature must leave much vague and much unsaid. Sufficient idea, however, is given to cause us to look forward to the complete work, which is, we understand, to be published by the Pitt Press shortly. In brief, the æther is composed of equal rigid spherical grains (diam. = $1 \cdot 7 \times 10^{-12}$ times the wave-length of violet light) arranged in regular and closest order, and under great pressure. When strained, such a medium must expand—or show "dilatancy." The actions of the medium depend on this dilatancy. Matter is a defect of matter—a small deficiency of grains or a "negative inequality," causing, so to say, a certain looseness in the gearing of the grains where the deficiency exists and a consequent stress in the medium outside. These inequalities are permanent, and are propagated through the medium without a transference of the grains themselves. Matter is, in fact, a strain which is propagated through the medium—an idea which has occurred to others, notably Dr. Larmor in his electron theory, and to the late Mr. C. V. Burton, at the Ipswich meeting of the British Association in 1895. These strains attract one another according to the Newtonian law, may cohere but not coalesce. "Positive inequalities" (due to excess of grains), on the contrary, repel one another and so are dispersed. Electricity apparently consists of double inequalities, excess in one place and defect in another. The statement here appears rather vague, and it is difficult to understand the difference between electricity and two inequalities, one positive and one negative. The attraction is, however, enormously greater than that of gravitation. Apparently the theory gives no explanation of the fact that electricity never shows itself apart from matter, nor is any explanation offered of the electrodynamic action of one current on a conductor bearing another. A true theory must do this, and it is the crux of every theory yet produced.

In this granular medium, transverse and longitudinal waves are propagated. It would take 56 million years to reduce the energy of the transverse to one-eighth, while it would take only four one-millionths of a second to reduce that of the normal by the same amount, thus, the author says, "accounting for the absence of normal waves." This, however, is only a proof that such waves do not last. It is necessary to show that on reflection of light they are not formed, otherwise they will diminish the intensity of the reflected ray.

Many difficulties and objections suggest themselves during perusal which will doubtless be answered in the full paper. If Prof. Reynolds does in this what he promises in the *résumé*, he will go down to posterity with a greater fame than Newton. If, however, he does not succeed in convincing us that he has solved the problem of the mechanism of the physical universe, he may yet be congratulated on giving us what is evidently a beautiful, illuminative and extremely suggestive theory. He has opened to us, in any case, a new field of knowledge as well as helped to stimulate that scientific imagination which we are told it is our bounden duty to cultivate.

W. M. H.

OUR BOOK SHELF.

Report of the Yellow Fever Expedition to Pará of the Liverpool School of Tropical Medicine. By H. E. Durham. Pp. 79. (London: Published for the University Press of Liverpool by Longmans, Green and Co., 1902.) Price 7*s.* 6*d.*

THIS is the seventh memoir published by the Liverpool School of Tropical Medicine, and it is printed and got up in the same excellent style as its predecessors. It embodies the results of the Parà expedition of Messrs. Durham and Myers, and is written by the former, Dr. Myers having, as is well known, fallen a victim to the disease he was investigating, a circumstance which lends a melancholy interest to the report. When the expedition left this country, the remarkable and conclusive work of the United States Army Commission in Cuba under Major Reed in proving the conveyance of yellow fever by gnats was not known, but this problem, with many others awaiting solution as regards the disease, was present in the minds of the observers, as is seen in the preliminary report, which is here reprinted from the *British Medical Journal.* In the course of their work, they became acquainted with the results of the Americans, and a number of observations are chronicled in the report with regard to the gnat (*Stegomyia fasciata*) incriminated in Cuba. It was bred in captivity and studied in its native haunts, and much useful information gathered as to its habits—the most striking being its essentially urban habitat, and its custom of biting by day and not at night.

With regard to the actual microbe which is the cause of yellow fever, no sufficient proof is as yet forthcoming, but the observations of the expedition agree with those of Agramonte and others in absolving Sanarelli's *Bacillus icteroides* from any share in its ætiology. Attention is, however, already called in the interim report, an abstract of which is here reprinted, to a small, fine bacillus which the English observers found with considerable constancy in the intestines and in the viscera generally in fatal cases, and to which they were inclined, with due reserve, to ascribe a causal significance. It had previously been observed by Sternberg and others, but not with the constancy here recorded. A valuable series of observations on the condition of the lymphatic glands in yellow

fever and another series on the occurrence of peculiar proteid substances in the urine must also be noted.

Together with these positive results, there is necessarily included a mass of detail concerning results which proved negative. The writer has, further, added to his account of the experimental work performed a quantity of somewhat miscellaneous facts gathered in Parà and elsewhere on the subject of yellow fever and malaria, with a general account of the sanitary condition of the town. But when it is remembered that the work of the expedition was in great part crippled by the illness of both and the death of one of its members, we can but congratulate the survivor on the work which was accomplished, regretting that opportunities were not forthcoming for carrying it to a further stage of completeness. Yellow fever is a disease which has long been a puzzle to sanitary science, but appears at the present day to be on the verge of explanation. An immense step in advance has been made by the discovery of its transference by the gnat; the complete solution of the problem must be attained by further investigations on the lines of those embodied in this report, and carried out by skilled and unbiased investigators such as those sent out by the Liverpool School of Tropical Medicine.

Eyes Within. By Walter Earle, M.A. Pp. 155. (London: George Allen, 1902.) Price 5*s.*

THIS little volume of poems contains some good references to Nature and her handiwork. We are led to realise the ever-changing condition of the earth's surface, and phenomena of many kinds are dealt with. Thus:—

> "See where upon a world-old mountain face
> Some mighty glacier has left its trace,
> A few faint scratches, all that marks to-day
> Time's agonies along his primal way."

Allusions are also made to the great variety of changes always going on around us, and to the disturbing elements raging ceaselessly in the interior of the earth:—

> "Shrill crash of breaker plunging in the cave,
> The soughing wind, waves grinding on the shore,
> Weird wail and scream of bird, set evermore
> In fuller diapason stern and grave."
>
> . . . . .
>
> "Crack, rent and crush of overwhelming rock,
> Steam bursting into flood of liquid blaze,
> A world vibrating with each thunder-shock,
> Suns setting in a pall of wreckage-haze.

All through the book we are struck with the delicate and subtle way with which common and every-day occurrences are referred to. Birds, flowers, insects, all have their due.

The author shows the true poetical spirit in many of his descriptions, and reveals to us the joy of possessing an eye which goes beyond the *outside* of the objects around it.

Handbook of Instructions for Collectors. Pp. v + 137; illustrated. (London: Printed for the Trustees of the British Museum, 1902.)

WITH the view of obtaining the aid of naval and military officers, explorers, missionaries and others whose duty or inclination takes them to foreign lands in adding to the collections of the Natural History Branch of the British Museum, the Trustees have issued this excellent little handbook. It consists of a series of pamphlets describing the methods of collecting and preserving the various groups of animals, as well as plants, fossils and minerals. The different sections into which the book is divided have been written by members of the staff of the Museum, each of whom is a specialist in his own particular branch, and although the manner of treatment varies somewhat, each section is admirably adapted to its special subject, illustrations being introduced when necessary. The section on mammal collecting is divided into two parts, one dealing with the larger and the other with the smaller forms, a feature of the former being the inclusion of a list of species specially wanted by the Museum. Birds and the lower vertebrates follow next, after which come the various invertebrate groups, the work closing with chapters on plant and mineral collecting. The book is of a size convenient to be carried in the pocket, and has the corners rounded off the better to withstand constant use. R. L.

The First Principles of Ratio and Proportion and their Application to Geometry. By H. W. Croome Smith, B.A. Pp. iv + 32. (London: Macmillan and Co., Ltd.) Price 1*s.*

THE strict theory of geometrical proportion is difficult, and, with few exceptions, elementary students are quite unable to understand it. Opinions differ as to the compromise that is best suited for school teaching, and suggestions on this topic deserve careful consideration. Mr. Smith bases his method on the variation of two geometrical quantities; it is supposed that they vanish together and that any given increment of the one is associated with a fixed increment in the other; or, as he puts it, "when two variables change in such a way that equal changes in the one are accompanied *always* by equal changes in the other." A theory of proportion which starts from this idea is necessarily imperfect, and ignores the most troublesome part of the subject; but it will probably serve very well as a provisional compromise. At any rate, Mr. Smith's book deserves a trial.

Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Pp. viii + 295. (London: Charles Griffin and Co., Ltd., 1902.) Price 7*s.* 6*d.*

THE nineteenth annual issue of this handy book of reference does not deal with a single calendar year, but with an actual working year of the great majority of the learned societies. Consequently, there are here brought together the papers read before the chief scientific societies throughout the United Kingdom from October, 1901, to June, 1902. The list of societies included in the new volume seems fairly complete, but we notice that the Geographical Association is not mentioned.

Papers on Etherification and on the Constitution of Salts. By Alexander W. Williamson, LL.D., F.R.S. (1850–1856.) Alembic Club Reprints, No. 16. Pp. 62. (Edinburgh: Published by the Alembic Club. Edinburgh agent, William F. Clay. London agents, Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1902.) Price 1*s.* 6*d.* net.

THE Alembic Club is doing valuable work by reprinting the accounts of classical researches in science in the words of the experimenters themselves. We are glad to know these reprints are increasing in popularity among teachers of science in schools where the "research" method of obtaining knowledge is encouraged. It is a matter for gratification, too, that this collection of papers, which have appeared in the publications of various scientific societies, has been printed during the author's lifetime.

Dove Dale Revisited: with Other Holiday Sketches. By the Amateur Angler. Pp. xiv + 130. (London: Sampson Low, Marston and Co., Ltd., 1902.) Price 2*s.* 6*d.* net.

THE amateur angler writes pleasantly of a beautiful country for which he has great affection. The volume is the seventh and concluding one of a series, and will encourage its readers to take an intelligent interest in animate and inanimate nature. The illustrations are numerous and exceptionally good.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Volcanic Dust Phenomena.

THE phenomena connected with the volcanic dust are undergoing distinct changes. In common with observers in the south of England, I noted the fresh appearance of the dust phenomena in the end of June, especially on June 26, but they were not very striking until August 1. At first the most decidedly volcanic feature was the great corona round the sun, known in the case of the Krakatoa effects as "Bishop's Ring." Whether this name should be applied to the corona this year is doubtful, as its radius has been fully double that of the Krakatoa corona, having until recently averaged about 70°, measured from the sun to the middle of the reddest part. Yesterday and this morning, however, it averaged only about 40°, and its reddest part was a yellowish-brown rather than a red. The colour of the corona this year has always been much less decidedly pink than was the case with Bishop's ring; indeed, it has sometimes been an absence of blueness in that part of the sky rather than any positive redness.

The pink glows after sunset were very strong in the end of June, but stronger still in November, and on November 1, 17 and 18 there was also a faint second glow, a phenomenon I had not previously seen since the Krakatoa sunsets.

It was not until October 30 that the colouring became very magnificent, and it reached its height about November 1, when the chief feature was an intense fiery orange sky near the west horizon. This was of an unmistakably volcanic character, different from anything that has appeared here since the Krakatoa sunsets, though not equal to those in splendour. Since that maximum, the colouring has been gradually lessening. Yesterday and to-day it was remarkably weak, the chief feature being the dust-wisps, which were more conspicuous than I have previously seen them during this apparition; indeed, I should have at first taken them for clouds had I not previously seen them in feebler form. They were plainest a little after sunrise and before sunset, when they were very bright and of a steely white.

The above descriptions apply to Sunderland; but in visits to Torquay from November 6 to 10 and to Dundee about December 1, the sky effects were not very different, only at Torquay I did not see the fiery orange.

Sunderland, December 16. T. W. BACKHOUSE.

P.S.—December 22. The fiery orange has reappeared.

The Methods of Investigating the North Sea Fisheries.

MANY of the readers of NATURE are interested in the international scheme of scientific investigation of the North Sea; but some at least are not convinced that the methods which are being employed are capable of yielding results of value as regards the condition of our fisheries.

The *essential* part of the scheme formulated at the conference at Christiania, at which the British delegates were Sir Colin Scott Moncrieff, Prof. D'Arcy Thomson, Mr. Garstang and Dr. Mill, is that each nation should fit out one or two specially equipped steamers, which should work along definite lines, and by means of which investigations as to the state of the fisheries, as well as hydrographical and biological investigations, should be conducted. The British Government agreed to participate in the prosecution of this scheme

But it has been repeatedly pointed out that, if conclusions as to the fisheries are to be drawn from the work of these steamers, two assumptions have to be made.

(1) That the take per steamer or per capturing unit is a measure of the abundance of fish, and

(2) That samples taken from small areas are representative of adjacent districts.

Both these assumptions have been severely criticised, and we had hoped that before now Mr. Garstang would have fulfilled the promise made by him in his letter to the *Times* of April 14 of this year; when he said, in reply to certain criticisms made by others and myself, that he "could see no reason for anticipating the reply which in due course and in the proper place will be made to the real authors of the criticism he (*i.e.* the present writer) adopts."

It will be remembered, (1) that the criticism referred to is that made by the Inspectors of Fisheries in their Report for 1900 upon the method of estimating variations in the density or abundance of fish by variations in the take per capturing unit, which was employed by Mr. Garstang in his "Impoverishment of the Sea." (2) That that criticism was published at least eighteen months ago, and that it is still unanswered by Mr. Garstang.

It was expected that at the meeting of the British Association at Belfast he would have taken the opportunity of meeting these criticisms. But he does not seem to have done so. For in reply to a letter asking him if he could refer me to any published refutation of these criticisms, he writes under date December 8, 1902, "I am unable to refer you to any published replies by me to the 'criticism' you quote, other than the *Times* reports of the Belfast meeting of the British Association and the Grimsby Conference of the National Sea Fisheries Protection Association (September 30 and October 1)."

The summaries of his communication at Belfast in the *Times* of September 13 and that in the *Times* of October 1 of his remarks at Grimsby give no indication that he dealt with the criticism, a criticism which, if it is valid, renders the results of the investigations recorded in his "Impoverishment of the Sea" of no value, and—what is of greater importance—throws grave doubts on the results to be expected from the international investigations at present in progress.

The publication of the Report of the Departmental Committee on Ichthyological Research, which has just been presented to Parliament, must be looked forward to with interest, since the Committee must necessarily have given some expression of opinion upon the questions touched upon in this letter.

D. NOËL PATON.

22 Lynedoch Place, Edinburgh, December 14.

Carved and Perforated Antlers.

IN NATURE for November 20, p. 55, there is a reference to the probable use of the carved and sometimes perforated antlers, by some called "batons de commandement." By Mr. A. W. Franks and others, in the "Reliquiæ Aquitanicæ," the simpler forms are recognised as the "Pogamagan" (*striker*) of the North American Indian (pp. 40, 50, 189, 200, and pp. 30, 102, 159 and 180, of description of the plates iii. and iv., xv. and xvi., xxx. and xxxi.). It seems to me important to mention that in Westminster Abbey a Pogamagan is sculptured as being held in the right hand of a North American warrior on Colonel Townshend's mural tombstone (dated near the end of the eighteenth century), on the south side of the nave.

December 13. T. RUPERT JONES.

St. Elmo's Fire during Snow Storm.

[MR. W. N. SHAW, secretary to the Meteorological Council, has kindly forwarded to us the following letter received at the Meteorological Office.—EDITOR.]

IT may be interesting to your Society to know that we find in a report received from our local committee at Margate relative to the launch of one of our lifeboats there, viz. *Eliza Harriet*, on December 3 and 4, that it is stated that about 2 a.m. a bright light was observed on the top of each of the lifeboat's masts, also one on the lee foreyard, which remained quite three-quarters of an hour and lit up all the wire pennants, making them perfectly clear. The lights in question appeared to be of the size of a small lantern. At the time it was blowing very hard and a heavy sea was running, and during the whole time it snowed so hard that it was impossible to see a yard in front of the boat. These lights continued until nearly 4 a.m. and finally disappeared on the snow lifting. It could not possibly have been a reflection from any light on the lifeboat, as they had none showing. It seems to us that this was probably a case of St. Elmo's fire, occasionally seen in a highly electrified state of atmosphere. CHARLES DIBDIN, Secretary.

Royal National Lifeboat Institution,
Adelphi, London, W.C., December 12.

THE FARTHEST SOUTH.[1]

IT is with a feeling of disappointment that one learns that the name of Tierra del Fuego does not carry in it the tradition of the volcanic fires which, though once seen by man, are now nearly all extinct; but we are told that the name was given by Magellan because of the immense number of fires lighted by the native Indians to keep themselves warm or cook their food, or give notice of the approach of strange craft. All the descriptions of the country connect it in climate with Chili, the land of snow, as its native name implies, and give greater prominence to its glaciers and icebergs than to its one still active volcano.

Fitzgerald has given a fuller account of the exploration of the same region as that traversed by Sir Martin Conway, and the aspects of Nature which struck both these travellers we may regard as characteristic of the region.

FIG. 1.—Nieves Penitentes in Process of Formation. (From Conway's "Aconcagua and Tierra del Fuego.")

Many of the accidents and incidents, often very untoward, which befell them both may be expected as inevitable accompaniments of exploration at great elevations, while others may be provided against when the traveller has realised what is before him and taken due precautions. Both watched the purple shadows creeping over the ocean, the gorgeous colours of the rocks and the deep blue of the ice. Both tell us of the rapidly rising torrent which carried off mule and man, of the glissade of the ponies down the steep talus of crumbling stone, of the struggle and recovery of the mule on the slippery rocks, of the frost-bitten guide, the mountain-sickness and other discomforts arising from impaired circulation and the want of constant supplies of warm and nourishing food, of the difficulties of the dense forest and spongy ground; and this similarity of experience and consensus of opinion warns the future traveller who may try those heights what to look out for and what to prepare for.

[1] "Aconcagua and Tierra del Fuego." By Sir M. Conway. Pp. xii + 252. (London: Cassell and Co., Ltd., 1902.) Price 12s. 6d. net.

Sir Martin Conway's diary, in its description of details, gives a freshness and local colouring to the story; even his constant references to the weather, by which, in such cases, the best-laid plans are often thwarted, do, in spite of Mark Twain's grumble, help the reader to realise the nature of the enterprise. Perhaps this remark would apply less strongly to his introduction of unexplained Spanish or native words with which his readers could not be expected to be familiar. We certainly do feel that we are reading about a foreign country when we come suddenly upon alameda, alfalfa, arriero, or pejerey, peon and posado. They have their effect, like "that blessed word Mesopotamia"; but we lose the thread of the story if we do not know whether our traveller has arrived at a wayside inn or a position of equilibrium at the bottom of a crevasse.

Darwin, in the "Voyage of the *Beagle*," has described the features of this interesting region more especially from the scientific point of view; Sir Martin Conway often helps us greatly to realise the general effect by pointing out that it is like something nearer home which his readers would probably have seen.

It is an interesting region. The double range of the Andes carved into every variety of peak and valley is submerged at its southern end so that the deeper hollows have been invaded by the sea, which fills a long trough parallel to the coast-line and many a transverse channel. He compares it to the Norwegian and Alaskan inland steamboat routes (p. 141). The submerged mountains are attacked by air and ocean with almost ceaseless fury, and we learn that it is not always safe to assume, when we see the tops of a group of mountains all touching an approximately uniform level, that we have there the wreck of a sea-plain or, as some would call it, a plane of marine denudation or base level of erosion, out of which the separating valleys have been carved after its upheaval, for here we have an example of a mountain region being submerged and the heights during any stationary period being planed off to a uniform level, the valleys having existed previous to the submergence.

The mountains around still rise so high that their snows feed glaciers which descend to sea-level. Before the submergence, their greater ice-flows crept further out on to the lowlands and left traces of ancient glaciation far beyond its present limit.

How recent some of the great geographical and climatal changes of the southern end of the Andes are, we may learn from a comparison of what the glaciers of Sarmiento were like when Darwin visited the straits and the same glaciers as seen by Sir Martin Conway. In

Darwin's time, they actually ended in the water, now they are cut off from the channel by belts of densely wooded moraine. The former greater extension of the ice is also shown by the way in which "the graceful ice-rounded foundation rocks of this and all the other mountains around slope up to the cliff and jagged arrêtes above" (p. 199), and proofs of oscillations of level are seen in the raised beaches and iceberg-carried boulders near Otway Water (p. 219).

Aconcagua (pp. 71, 72) towers into the sky, the grandest peak of the southern Andes. It appears to be built up of approximately horizontal beds of volcanic rock of different texture, hardness and friability, which are carved into steps like those which gave their name to the "trap" rocks of Sweden. The steps are better preserved towards the right- and left-hand sides of the slope than in the middle, where the downward drift of débris and the fall of avalanches are most common. The edges of the steps are there completely worn away and buried. The flow of débris down the face is such that the fragments tend to become rounded or subangular, like pebbles in a brook by their friction against one another. When he was descending the mountain, the stones at one point (about 20,500 feet up) poured away beneath his feet and disclosed the subjacent rock, which he perceived to be ground quite smooth by the passage of the débris over it.

Sir Martin gave some time to the examination of those curious remnants of great slipped or drifted masses of snow, the *nieves penitentes*, so called because they stand like devotees enveloped in shroud-like robes doing penance. They require peculiar conditions for their full development, and therefore, although somewhat similar pillar-like remnants of melting snow may sometimes be seen even in this country, they are not common anywhere in the Old World and only over limited areas in South America. They are cut out of avalanche snow which has been subjected to pressures roughly perpendicular to the direction of its fall, and thus hardened into approximately vertical strata of different densities. The wind has nothing to do with their origin, but they are carved out by the melting action of direct solar radiation. They are roughly elliptical and somewhat bent over to the north, the major axis of the elliptic sections being oriented east and west. On searching for *penitentes* in different stages of development, he found that a thick bed of well-compacted snow, when exposed to the action of the sun, soon becomes pitted over with little saucer-like depressions, and the deeper these become, the less power has the sun's rays upon their sides and the more upon the bottoms of the depressions. The hollows enlarging ultimately run into one another, leaving rough pyramids of snow standing up between them, until at last the ground is reached; the spires are entirely separated from one another and are seen standing about on the stony floor like separate sugar cones.

FIG. 2.—Nieves Penitentes; the last stage. (From Conway's "Aconcagua and Tierra del Fuego.")

There is also a mountain called Penitentes (p. 108), from the weathered-out columnar structure of the rocks which form its summit, not unlike what we sometimes see in our strongly jointed Mountain Limestone or Millstone Grit.

Many other curious questions arise out of an examination of such an area; for instance, the great unconformity (p. 105); the inosculating valleys (pp. 127, 131); the landslips and rock creep, or rivers of mud and stone, similar to those described by Heim in Switzerland; the moraines modified by blown sand (pp. 55, 56).

So little has been done towards the exploration of those strangely varied and, for most people, inaccessible regions that we gladly welcome Sir Martin Conway's diary of his adventurous journey through southern Chili and Tierra del Fuega, and of his difficult climb and almost equally dangerous descent of Aconcagua and Sarmiento. T. McK. H.

SECONDARY AND TECHNICAL EDUCATION.

NOW that the Education Act has become law, one of the first duties of the newly constituted local authorities will be to determine what are the educational needs of their districts and how far these needs are met by existing institutions; they will then be able to decide in what directions increased educational facilities are needed and how they can most efficiently provide what is wanted.

It is in the domain of secondary education that such a survey as is foreshadowed above is likely to form most

frequently the basis for a demand for a revision of the curricula of some of the schools in the district. Thus, in many of the administrative counties, we still have too many schools which devote a large amount of time to the study of classics, not because most of their pupils are best fitted for life by such study, but mainly because the school prepares each year a boy or two for Oxford or Cambridge. Wise county councils will probably decide to limit the number of classical schools within their counties, sending, by means of scholarships, the best boys capable and desirous of receiving a good classical education to one or more selected schools in the district. The remaining county grammar schools will, it may be hoped, be modernised and adapted to the needs of the bulk of the pupils attending them. In many, a strong agricultural side should be developed; in some, a good modern education should be given.

It will be asked, "What is here meant by a good modern education?" In the opinion of the writer, this should include English—taught much more thoroughly than is usually the case in grammar schools, where classics absorb the lion's share of the pupil's time—and mathematics, based on practical measurements and including a knowledge of geometry gained by methods more suitable for boys and girls than those set forth in Euclid's elements. German, taught by colloquial methods, should be a compulsory subject because the study of its grammatical peculiarities forms a mental training as useful as can be given through the medium of Latin or Greek, and because it is becoming increasingly difficult for one who does not know this language to follow the latest developments in either industry or commerce. French should also be taught where possible, but in cases where only one language can be learned, it should be German. Drawing would naturally form part of the course, and some suitable form of manual training, such as modelling or woodwork, should be introduced.

Above all, it is to be hoped that local authorities will discourage the pseudo-classical schools which have sprung up in the last two decades owing to the desire of some ancient grammar schools to meet the demand for the teaching of modern subjects while still devoting some portion of the school time to Latin. The result is—what might be expected—that neither Latin nor modern subjects are mastered; the pupil has a smattering of too many things.

Although a diminution in the amount of classical teaching is here advocated, it must not be supposed that the value of sound classical training is underestimated; where a pupil's time suffices for this as well as for the subjects he needs to enable him to earn his living, it is well that he should study Latin and, if possible, Greek. But in cases where the school life of a boy or girl is necessarily limited, it is much better that his or her mind should be trained through the medium of subjects likely to be of greater service in after life; above all, it is very doubtful whether a child obtains any substantial benefit from a classical training so imperfect that he remains unable to appreciate, or even to read easily, classical literature.

In the towns, the matter will be more complicated. Many local authorities will have to determine how best to deal with the higher grade board schools, where they exist. In each town, the problem will be different; where the towns are badly provided with secondary schools, it may be wise to convert the higher grade board schools into secondary schools, but, in such cases, they should not be allowed to strangle existing efficient secondary schools by providing education of the same kind as these schools offer, practically free of charge. If the circumstances of the town make it desirable that secondary education of a certain type should be offered free, then all the schools of this type should be placed in a position to offer the same terms to their pupils, so that such competition as exists will depend only on the relative efficiency of the teaching in the schools. On the other hand, in some towns the higher grade board schools have been competing needlessly with secondary schools in their neighbourhood. In such towns, the higher grade board schools can be converted into higher elementary schools, giving a training for the large number of boys and girls who must leave school at a comparatively early maximum age, say fourteen or fifteen. Indeed, as recent Parliamentary returns show, there are, in most higher grade schools, very few boys or girls above fifteen, except backward ones. The curricula of these schools should be materially altered; they are at present far too ambitious, having regard to the average age at which their pupils leave, and should be amended so as to include only that amount of work which can be satisfactorily covered, and the comparatively few pupils for whom the present curricula are devised should be transferred, by means of scholarships, to secondary schools.

One of the most fertile causes of the comparative inefficiency of some of the secondary schools in this country is the large number of examinations for which they find it necessary to prepare their students. Thus we have, not only the examinations of the Board of Education, but also the local examinations of the various universities, special examinations for the Army, the Navy, the Civil Service, different county and other scholarships, &c. It would be an enormous gain if, in place of all these various examinations, we had one State examination, on the results of which there would be issued a certificate, guaranteeing a good general education and recognised as qualifying for admission to the universities, the Civil Service, the Army, the Navy, &c. Unfortunately, enormous vested interests are opposed to such a plan, as the present system of indefinite multiplication of examinations finds employment for a large number of examiners and is stamped with approval by the action of the older universities, which have in recent years extended their system of local examinations so as to include quite young children; *e.g.*, the maximum age for admission to a so-called "honours" class in the preliminary local examination of the University of Cambridge is fourteen!

Assuming that a suitable basis for technical education has been made by the provision of an adequate number of secondary schools, it will then be necessary to consider what technical institutions are needed in the district. This will, of course, depend largely on the nature of the industries which exist in particular neighbourhoods. In many administrative counties, the only technical institution needed will be an agricultural college, and for some counties a share in an agricultural college would suffice. In other administrative counties, provision must be made for proper technical instruction in such subjects as coal mining, metallurgy, fisheries, &c. But, as a rule, the county will find much of what it wants in the large technical colleges already existing in the great cities within, or adjacent to, the geographical borders of the county.

In many of the smaller county boroughs, there are already technical schools providing evening classes for artisans; in the remainder, such evening classes might not infrequently be provided in connection with the modern secondary school of the place. In large cities, which are great centres of population, a first-class technical institution will be needed, providing not only evening classes but more especially instruction for adult day students on a par with that given in Germany and the United States. This can only be done effectively by concentrating in one institution for each district either all the higher technical education or, at least, the highest part of such education in a certain number of branches of technology and commerce. For it is only in institutions with numerous pupils that it is economically justifiable to provide the expensive equipment needed for such work

and the large number of highly paid specialist teachers who ought to be employed therein.

At present there is no technical institution in the United Kingdom which is staffed on a scale even approximately equal to that of such foreign institutions as the Charlottenburg Technical High School, Berlin, and the Massachusetts Institute of Technology, Boston. In these magnificent technical high schools, in place of two or three professors, *e.g.*, of engineering, we find a very large number of highly qualified men, each dealing with some special branch of engineering knowledge, and this can be economically done because of the very large number of engineering students gathered together in one institution. In this country, at present our comparatively few adult engineering day students are scattered among a relatively large number of institutions; as a result, such far-reaching subjects as electrical engineering have to be entrusted to a single professor. Indeed, there are some technical colleges in which there is only one professor of engineering, and electrical engineering is in charge of a poorly paid assistant lecturer.

To remedy this, coordination of work is necessary, not merely within the great towns, but even between neighbouring educational authorities, which are not infrequently jealous of one another and pursue their work regardless of what is going on around them. Hence we have cases of towns within easy reach of one another where technical institutions have been established, each of which tries to do the highest possible work in all the subjects which it undertakes. The result is a small number of students in each subject in each town and a staff of teachers proportionate, it is true, to the number of students, but inadequate for the purposes of advanced technical education. It would be well, therefore, if power were given to the Board of Education to select a limited number of central institutions where alone higher technical education in the day-time should be given.

Liberal financial aid will be needed to place such institutions on a satisfactory basis, and as they will be national rather than local institutions, a large part of the money for their support should be provided from the imperial exchequer; the remainder should be contributed by the various local authorities in the districts which they serve.

Another important matter which must be determined is the relation of institutions providing the highest kind of technical training to the universities or university colleges in the same district. The best solution of this problem in such a case as, *e.g.* Manchester would be for the technical institution to absorb all the higher technical work of the city and for the university college to devote itself to the faculties of theology, literature, philosophy, medicine, law, pure science, music, &c. Where local universities are established, the technical institution would become the faculty of technology and commerce; it should not be subjected to the academic control of the university, which might tend to destroy its usefulness for industrial and commercial purposes.

The great technical institutions of Germany and America exist side by side with important universities; they are, however, independent of these, and it is partly to this fact that they owe their usefulness in promoting the industrial progress of the German and American nations.

An important problem for the new local educational authorities will be the training of teachers of trade subjects. It is easy to find men with a good knowledge of their respective trades, or persons who can teach well, with a superficial knowledge of an industry, but the combination of these qualifications is comparatively rare. It is not easy to see how this can be speedily remedied, but an improvement might be produced by arranging a higher scale of remuneration for teachers of trade subjects who had passed examinations giving evidence of their power to explain in simple language matters connected with their own industry. More than this it is probably impossible to demand at present.

As regards the more highly qualified teachers needed for adult day classes in technical institutions, one of the greatest difficulties is how best to keep such men in touch with their respective industries. If the teacher's whole time is not required for the work of the institution, he can remain in contact with the industry by doing consulting work and by research. Unfortunately, in such cases there is often a tendency for him to regard his teaching work as the least important part of his occupation; in fact, one has known cases where the principal value of such a teacher to his students has been the fact that his name was well known in the industry and his recommendation consequently a valuable one, though his actual teaching work was of a merely nominal character. The cure for this would be to make the pay which the teacher receives for teaching by far the largest part of his income; such an arrangement would, however, mean a considerable increase in the salaries of teachers of technical subjects, but, in the opinion of the writer, it would be justifiable, as it would make it possible for some of the best men to continue teachers; at present, such men are attracted to the industries by the incomparably larger financial prizes which they offer. J. WERTHEIMER.

PREVENTION OF RABIES.

A LETTER headed "Mr. Hanbury admits the failure of the muzzle" has been addressed to us by a member of the executive committee of the National Canine Defence League, which letter, as might be expected, urges in so many words on behalf of the canine species the total abolition of the muzzling order at all times and under all conditions. The writer of the letter vindicates for himself, as might also be expected, a superior knowledge concerning rabies, its nature and its mode of spread; he, as a matter of course, is one "who understands dogs" and considers "that the muzzle was from the first condemned as useless cruelty." According to this authority, the Board of Agriculture, including, we presume, its veterinary department, "itself ignorant of dogs and their diseases, has persistently refused to be advised and guided by those who do possess the requisite knowledge" (*sic!*).

To be serious, it is no new thing that there never is any lack of amateurs who, notwithstanding the obvious want of special knowledge required to form an opinion, are in their own estimation quite capable of judging of the merits or demerits of a question that can be only dealt with adequately by the specialist possessed of the requisite knowledge.

Rabies is an infectious disease, directly communicated by the bite of a rabid animal, in the vast majority of cases a rabid dog. In the interest of the animals themselves—all domestic animals are susceptible to the disease—and above all in the interest of human beings, the disease should be, and as a matter of fact has been, controlled, checked and prevented from spreading by the thorough, not half-hearted, carrying out of the muzzling order: that is, the slaughter of ownerless and stray dogs—the most dangerous because the most frequent means of contagion—and by the muzzling, not merely the pretence of muzzling, of all dogs, so as to include also those that may and sometimes do harbour the contagium before the actual disease has fully declared itself in them. Such is the practice, the only rational practice, which is followed, and successfully followed, in other countries at times when rabies makes its appearance. The private opinion of Mr. Hanbury or any other politician on this subject, and the complaint that—owing, most probably, to the loose and half-hearted manner of

administering the muzzling order—rabies has not been stamped out in Wales, does not touch the real merits of the question.

Mr. Long, the former President of the Board of Agriculture, who has proved himself thoroughly well instructed in the whole question of rabies, has with laudable firmness resisted the outcry and the repeated assaults of the uninstructed sentimentalists, and as a result was able to demonstrate that by the strict carrying out of the muzzling order rabies in England was checked and was almost reduced to extinction, though at first it was so prevalent as to be really alarming. It seems hopeless to discuss this or any other dog-question with people who, in the face of all expert opinion as regards prevention of rabies, and particularly against the opinion of sensible owners of dogs, can write that "the muzzling order and the muzzle are a gross and wanton cruelty to animals."

But even if it were not an exaggeration, as we are persuaded it is, that the owners of dogs in general object to the muzzling order and consider it a cruelty to animals, what about the human species? Human beings who are not members of the executive committee of the National Canine Defence League regard the muzzling order as an important safeguard. One of the duties of the State is to protect the health and lives of its citizens. Hydrophobia of man is one of the most terrible diseases, and the slaughter of stray dogs and the muzzling of all dogs in places where rabies is rife has been proved to be at present the best and only means to prevent the spread of the disease to man. Besides, it should be the interest of owners of valuable animals to insist on the retention and strict carrying out of a measure which to a very large extent insures against the spread of rabies and consequent loss—seemingly of indifference to the members of the Canine Defence League.

RECENT WORK OF THE GEOLOGICAL SURVEY.

The Report referred to below[1] shows that the Geological Survey continues with activity and success its investigation of the geology of these islands. It bears witness to a large amount of steady and useful routine work, which may not make much show, but which will contribute to our knowledge of the detailed structure of these islands and in some instances will have direct economic usefulness. Among the more interesting scientific results of the year's work, the progress of the re-examination of Cornwall has brought to light evidence of a younger granite than the main mass of that rock, showing that the granitic intrusions form a somewhat more complex series than had been supposed. The clue, however, to the detailed structure of the so-called "killas" and the boundaries between the true Devonian and older rocks still eludes the keen eyes with which the surveyors are searching for it. If we could hope that the appointment of a mining geologist would do anything towards reviving the decayed mining industry of the region, we should still more rejoice in this increase to the strength of the staff. Another of the problems which for years past has baffled the officers of the Survey is that of the Old Red Sandstone of South Wales. They are still unable to draw any satisfactory line between the lower and upper divisions of the system. If the key is not found before the western coast is reached, we can hardly hope that it will be discovered in any part of this region.

Some interesting discoveries were made during the year in Scotland. Foremost among these is the finding of proof that the granite of south-west Argyllshire has invaded and altered a portion of the Lower Old Red Sandstone series of Lorne. The importance of this new fact lies in its relation to the history of the metamorphism and igneous protrusions of the Scottish Highlands, for it shows that some of the granitic masses, like those of Galloway and Leinster, are certainly post-Silurian in age. Another notable "find" is that of the zone of *Pecten asper* in the island of Scalpay and of Upper Cretaceous rocks in the sound of Soay.

In Ireland, the energies of the Survey are now concentrated on the Drift, with the view of preparing accurate maps of the superficial deposits of the country. But under Mr. Lamplugh's direction, the geological interest of the glacial geology is not likely to be lost sight of. One of the features of the work in the Dublin district was the finding of evidence which seems to support the view that the eskers represent water-channels which existed under the ice-sheet.

A new arrangement has been made in this Summary. Its materials are grouped by districts instead of, as formerly, by formations. The change will no doubt save trouble in the preparation of the volume, but it gives a great deal more to the geologist who wishes to ascertain what additions to our knowledge the Survey has been able to make in any particular part of the geological record. Another change is the omission of the Director's name from the book. It surely cannot have been the wish of those who wield the new brooms at South Kensington to sweep Mr. Teall's name clean out of his Report.

[1] "Summary of Progress of the Geological Survey of the United Kingdom and Museum of Practical Geology for 1901."

PROF. P. P. DÉHERAIN.

Déherain (b. 1830, d. 1902), who in 1887 succeeded to Boussingault's place in the Académie des Sciences, was, for the last twenty-two years of his life, professor of vegetable physiology as applied to agriculture at the Muséum in Paris. His early work was chiefly agricultural, and included researches on calcium phosphate, on the salts of potassium, &c.; he was author of a "Cours de Chimie agricole," and it should not be forgotten that he founded the *Annales agronomiques*. In the region of pure physiology, he was author of a number of memoirs, of which those written in collaboration with Maquenne, Moissan and others are perhaps especially well known. He worked at gaseous interchange, including the absorption of oxygen by succulents and by oily seeds, also at the assimilation of CO_2, being especially interested in the action of the different parts of the spectrum on this process. His researches extended to other subjects, such as transpiration, the assimilation of free nitrogen and denitrification.

A sympathetic appreciation of his personal character and of his career as a teacher is given by his former pupil, Maquenne, in *La Nature* of December 13, to which we acknowledge our indebtedness. Although Déherain's name is not associated with any great discovery, he deserves the place he won for himself in the annals of plant-physiology and the honour due to one who dies in harness. F. D.

TRANSATLANTIC WIRELESS TELEGRAPHY.

Mr. Marconi's latest success is a wonderful achievement. Messages have been exchanged in both directions across the Atlantic, between his two new stations at Glace Bay, Cape Breton, and Poldhu, Cornwall. Transatlantic wireless telegraphy has thus been successfully established; and the persistent effort which has enabled this result to be accomplished merits the fullest recognition. The messages which we print from the *Times* represent the inauguration of a system of

communication which is not only of the highest scientific interest, but also of practical importance.

The following messages and particulars referring to them appeared in the *Times* of December 22 and December 23:—

Ottawa, December 21.

The first message to be sent across the Atlantic Ocean by wireless telegraphy was despatched to-day to King Edward by Lord Minto. Notice of its successful transmission was received to-night by the Governor in the following message:—

"Glace Bay, Cape Breton.

"I have the honour to inform your Excellency that your message to his Majesty has now been transmitted by me from Cape Breton to Cornwall by wireless telegraphy, and has been forwarded to its destination.—G. Marconi."

Lord Minto replied as follows:—

"I am delighted at your message, which I have just received. My warmest congratulations on your spendid success."

December 22.

King Edward has replied to Lord Minto's telegram sent to His Majesty by Signor Marconi's apparatus, as follows:—

"I am much interested by the wireless message which you have sent me, and am delighted at the success of Signor Marconi's great invention, which brings Great Britain and Canada into still closer connection.—Edward."

On Monday, the *Times* published the following message from its correspondent at Glace Bay:—

"Being present at its transmission in Signor Marconi's Canadian station, I have the honour to send through the *Times* the inventor's first wireless Transatlantic message of greeting to England and Italy."

The following message, also transmitted by wireless telegraphy, was published on Tuesday:—

The Government of Canada, through the *Times*, desires to congratulate the British people on the accomplishment by Marconi of the greatest feat which modern science has yet achieved.

"Cartwright, Acting Premier,
"Ottawa, December 21."

NOTES.

The King of Denmark has conferred upon Lord Lister the honour of Knighthood of the Grand Cross of the Order of Dannebrog.

M. Darboux, permanent secretary of the Paris Academy of Sciences, has been appointed a member of the Bureau des Longitudes in succession to the late Prof. Cornu.

Mr. C. A. Angot, of the Bureau central météorologique de France, and Prof. W. L. Moore, of the United States Weather Bureau, have been elected honorary members of the Royal Meteorological Society.

The council of the Manchester Literary and Philosophical Society has awarded the Wilde gold medal for 1903 to Prof. F. W. Clarke, of the United States Geological Survey, and a Dalton medal to Prof. Osborne Reynolds, F.R.S. In view of the fact that next year will mark the centenary of the discovery by Dalton of the atomic theory, Prof. Clarke (whose writings on the atomic weights are well known) has also been invited and has consented to deliver the Wilde lecture for 1903. The presentation of the medals and the delivery of the lecture will probably take place in May, 1903.

At the general meeting of the Zoological Society of London on December 18, it was announced that Mr. William Lutley Sclater had been selected by the council out of twenty-two applicants for the vacant post of secretary. Mr. Sclater is now director of the South African Museum, Cape Town, and has previously held appointments as science master at Eton and as assistant director of the Indian Museum, Calcutta. He is a well-known authority on the mammals and birds of India and Africa, and on other zoological subjects, and is at present editing a series of volumes on the fauna of South Africa, of which four have already been published.

We regret to record the death, on December 13, of Dr. John Young, late professor of natural history in Glasgow University since 1866.

The death is announced of Prof. Zaayer, professor of anatomy in the University of Leyden. The death is also announced of Prof. Leonard Landois, professor of physiology at the University of Greifswald (Pomerania).

Mr. T. Brice Phillips, of Uckfield, has been awarded the prize of fifty pounds, together with a silver medal, offered by the council of the Society of Arts for his essay on "Existing Laws, By-laws and Regulations Relating to Protection from Fire, with Criticisms and Suggestions." Prizes of ten pounds with a bronze medal have also been awarded to Mr. George H. Paul and to Dr. W. C. Henderson.

It is announced in *Science* that the Section of Geology and Geography of the American Association for the Advancement of Science, which will meet at Washington on December 27, has arranged to devote a session of the meeting to the discussion of the recent eruptions of Mont Pelée and La Soufrière by Messrs. Russell, Hill, Heilprin, Jaggar, Curtis and Hovey, who visited the islands of Martinique and St. Vincent a few months ago.

The Coats family have given 10,000*l.* between them to the cancer research scheme, 5000*l.* being from Sir Thomas Coats and family, and 5000*l.* from Mr. Archibald Coats and his two brothers. The *Times* states that a few more such contributions would bring the fund up to the required amount, and would enable the investigations to be carried through on the comprehensive lines indicated in the scheme which was formulated and is being directed by the Royal Colleges of Physicians and Surgeons.

A Reuter message states that at 9.30 a.m. on December 16, Andijan, in the province of Fergana, Russian Central Asia, was totally destroyed by an earthquake. Andijan is a town of about 50,000 inhabitants. According to a rough estimate, 16,000 houses have been destroyed and 2500 persons killed as a result of the earthquake. Subterranean rumblings and tremblings of the earth continue. At New Marghelan, the capital of Fergana province, the shock lasted nearly three minutes. The direction was from north-east to south-west.

A telegram to the Paris *Petit Journal*, dated December 17, states that for several days past Mount Vesuvius has been throwing out rock masses, vapour and dust.

We learn from the *Times* that news has been received at Stockholm that the Swedish Antarctic exploration ship *Antarctic* left Tierra del Fuego at the beginning of November on its second summer expedition. It was expected that the expedition, after some cartographic work and natural historical research in the northern and western portions of the Dirck Gerritz Archipelago, would arrive about December 10 at the winter quarters in Snow Hill Land, where Dr. Nordenskjöld would resume the leadership of the entire expedition. The *Antarctic* will probably return to Port Stanley (Falkland Islands) at the end of February or the beginning of March.

In the House of Commons on December 16, the President of the Board of Trade was asked whether he was aware that three dangerous varieties of colour-blindness escaped detection by the Board of Trade test, whilst many normal-sighted persons were rejected by it. In reply, Mr. Gerald Balfour said the present

system was adopted on the recommendation of a committee appointed by the council of the Royal Society, and that the Board of Trade in doubtful cases had the assistance of the gentleman who acted as secretary to the committee. The President of the Board of Trade said he did not think there was any necessity for a small departmental committee to reconsider the test in the light of recent discoveries, as had been suggested.

Mr. Francis Watts, Government Analyst and Agricultural Chemist for the Leeward Islands, sends us from Antigua the following particulars of recent high tides received from correspondents in various neighbouring islands, and possibly connected with changes due to the late volcanic disturbances:—*Barbuda.* During the month of October and early in November, the tide was abnormally high, the rise being from 18 inches to 2 feet above the ordinary. Old inhabitants do not remember a like rise, except perhaps in a severe gale such as a hurricane, and then only for a short time.—Oliver Nugent. *Nevis.* Tides unusually high for eight or nine days, commencing about November 1.—R. B. Roden. *Dominica.* Tides unusually high for few weeks ending November 12, the level being constantly at about high-water mark. No determination had been made whether this was caused by high tides or change of level.—W. H. Porter. *Tortola.* Tides much higher than usual—a fact generally commented upon and noticed while bathing. No exact observations made, but the difference could safely be put down as a foot in depth.—Dr. Cookman. Referring to these records, Mr. Watts remarks, "Of course, it may turn out that there has simply been an abnormally high tide throughout the Leeward Islands, but so far the tide does not seem to have returned to its normal height. Observations will be continued and submitted from time to time. It will not be a very easy matter to determine if there have been slight changes of level, particularly in places where the shore is very steep, as it is in many of the islands of volcanic origin."

An aëronautical problem of some interest, and of far less difficulty than the problem of artificial flight, is the performance of journeys across the sea in a balloon. In *La Nature* for November 15, Lieut.-Colonel G. Espitalier gives an illustrated account of M. Henri Hervé's balloon, the *Méditerranéen* No. 2, and the methods adopted for directing it at sea. In order to prevent the balloon from being depressed by a shower of rain, its top part terminates in a cone. Instead of trailing a single guide rope, M. Hervé proposes a system of "triangulation," consisting of a trailer floating at the end of a long rope behind the balloon, and a balance weight hanging in the water by a nearly vertical and shorter rope, the resistance of the latter body being necessarily smaller than that of the former. The sea itself furnishes an inexhaustible supply of ballast, and this can be drawn up into a cylindrical reservoir suspended above the balance weight, a suction hose being used for filling the reservoir when required. This "compensator" is fixed near the surface of the water. M. Hervé employs two deviators for diverting his balloon by the action of the water, one, which he calls a "minimum deviator," for angles of about 30°, and the other, the "maximum deviator," for angles which are alleged to reach as much as 70° or 80°. M. Hervé first experimented in this direction on the North Sea in 1886, and last year he transferred the seat of his operations to the Mediterranean.

In a message from Buenos Ayres, a correspondent of the *Times* states that Mr. Reginald Rankin made the ascent of Aconcagua alone on December 14, having been deserted by his native guide. Being caught by a snowstorm, Mr. Rankin spent the night in the open at 22,000 feet, and on December 15 walked and rode continuously to Puente del Inca, a journey of 12½ hours, with frostbitten hands and feet. His toes have had to be amputated, but his fingers will probably be saved.

Until recently, a rule has been in force in the Lahore Veterinary College prohibiting *post-mortem* examinations of cows or pigs or any other "sacred or prohibited animals." We learn from the *Pioneer Mail* that the principal has subjected the carcass of a bull to examination for educational purposes and has declared that in future the thing will be done as a matter of course. The Bengali Press is indignant and prophesies the most dire results to British rule if the practice is continued, but it is difficult to see how veterinary surgeons can be trained satisfactorily without practical dissection of the kind to which objection is taken.

In our correspondence columns of December 4 (p. 103), under the title "Germs in Space," the suggestion was made that the dust which reaches the earth from space may contain living as well as dead matter. Mr. John Munro writes to say that in the "Bijou" biography of Lord Kelvin, published some time ago, the same view is expressed in the following passage. The passage runs (p. 81):—"Nay, it seems rather a crude hypothesis, for the seeds of life may be floating like meteorites in space and ready to sow the crust of a new and virgin planet."

Dr. H. Hergesell, President of the International Aëronautical Committee, states that the results hitherto obtained from the monthly balloon ascents have justified in every way the continuation of the experiments, and that it is proposed to continue them during the year 1903. During the current year, about 110 registering balloons and 52 manned balloons have been sent up. In addition, kites have been regularly employed in Europe and Boston, U.S.; on two occasions, they were also flown from steamers on the Lake of Constance. The complete results for the year 1901 will be published shortly, and those for 1902 are also in the press.

Several interesting articles of a semi-scientific nature appear in the Christmas number of the *Gardener's Magazine*, notably the description by Mr. J. Yeld of a climbing tour through the south-western Alps, and a historical account of the gardens at Hampton Court by Mr. G. Gordon. A calendar for the new year is included in the issue.

An investigation into the causes of larch and spruce fir canker, by Mr. George Massee, forms the subject of a publication by the Board of Agriculture. The fungus which generally attacks the larch is *Dasyscypha calycina*, and an allied species, *Dasyscypha resinaria*, is mainly the source of trouble in spruce canker; but these species are not easily distinguishable except to the expert. These two forms are not confined to the larch and spruce, but they may attack certain pines and firs, while other species also are destructive to coniferous trees. Mr. Massee confirms Hartwig's conclusions that they are wound parasites and finds that aphides are frequently the cause of trouble, although late frosts, which induce rupture of the bark and consequently extrusion of sap, are also a source of danger. Seedlings and young trees may be protected by spraying, but in the case of older trees the disease cannot be eradicated.

A history of systematic botany prior to Linnæus is given by Dr. B. Schorler in the *Sitzungsberichte* of the "Isis" Society of Dresden. To Aristotle is attributed the commencement of the study of botany as a branch of science; Theophrastus observed about 450 plants, Dioscorides about 800. According to Dr. Schorler, the earliest herbariums now extant are those of Aldrovandi in Bologna, Girault in Paris, Caesalpini in Florence, Hernandez in Escurial (Spain), Rauwolff in Leiden, Harder in Ulm, Ratzenberger in Cassel, Caspar Bauhin in Basle and von Burser in Upsala.

In a series of articles upon the dissociation of matter, which have been published in some of the recent issues of the *Revue Scientifique*, M. Gustave le Bon gives an interesting account, partly historical and partly descriptive, of the experiments

performed by himself and others on radio-activity, and of the theories which have been based upon them. The final conclusion at which he arrives is that kathode rays, X-rays and all the various phenomena of radio-activity appear to be particular aspects of a new form of energy which is as common in nature as electricity or heat, and the closer study of which may reveal to us a connecting link between matter and energy.

WE have received a copy of vol. xvi. of the *Journal* of the College of Science of the Imperial University of Tokyo, which contains a number of interesting contributions on electrical subjects. The first of these, from the pen of Mr. Y. Homma, discusses some of the observations on atmospheric electricity made at the Central Meteorological Observatory of Japan, dealing more especially with the effects of wind, fog, rain and snow on the atmospheric potential. The remaining papers, six in number, are contributed by Prof. Nagaoka, Mr. K. Honda and others, and all deal with magnetostriction and other allied phenomena in ferromagnetic substances. Those interested in the subject may be referred to these papers as containing the records of much valuable experimental work.

REFERRING in these columns a few weeks ago to the manufacture of apparatus from vitreous silica, the hope was expressed that our manufacturers at home were not going to be left behind in the application of this art. We have since learnt that Messrs. Baird and Tatlock have been manufacturing silica vessels by Mr. Shenstone's process for the past eighteen months and are prepared to make a variety of apparatus to specification.

THE Paris correspondent of the *Times* states that an automobile system is to be tried on the lines of the Paris-Lyons-Marseilles Railway. The trial trip is to be made by three cars next June from Paris to Dijon, and it is hoped to cover the 300 kilometres in a little more than three hours, or at an average rate of about sixty miles an hour. Each car is to be of the same size as an ordinary corridor carriage and capable of seating forty passengers; the petroleum engine is at the front of the car. The cars are to be built by Messrs. Gardner and Serpollet and will have the same weight as a corridor carriage. At present it is only intended to try the system for passenger traffic, but if it is successful it will doubtless be widely extended. It is also announced that a similar system is to be tried on the North-Eastern Railway between Hartlepool and West Hartlepool, where there is keen competition between the railway and the tramway. These cars are to carry a petrol engine driving a dynamo which will generate electric current for the actual driving motors.

A BRIEF description of the laboratories recently fitted up for electrochemical analysis at the Chemical Institute at Nancy is given by M. Arth, director of the Institute, in *l'Éclairage Électrique* for December 13. There are two rooms, one of which serves as a balance and apparatus room, the other containing the working benches. The laboratory proper is fitted up with two double tables each capable of accommodating eight students and a single table having room for two more. Each student has at his disposal two sets of leads, which can be connected to a supply of suitable voltage, a rheostat, and terminals by means of which an ammeter and voltmeter can be put in circuit. There is one ammeter and voltmeter provided between the four students working at the same side of the table, so that they have to make their measurements in turn, but these are so connected that the measurements can be made without interrupting the circuit. Extra terminals are, however, provided, by means of which additional apparatus can be connected in circuit. The circuits are purposely so arranged that the operations are not made too automatic, but the student has to understand what he is doing each time he makes a connection or a measurement. A full set of platinum electrodes, dishes, &c., completes the equipment.

THE river terraces in New England form the subject of an essay by Prof. W. M. Davis (*Bulletin* Museum Comp. Zool., Harvard College, vol. xxxviii.). He discusses the formation of terraces in valleys occupied by drift, and urges the importance of studying them in plan as well as in section. He points out that they may be accounted for, firstly, by the behaviour of a meandering and swinging stream, slowly degrading the valley deposits; and, secondly, by the control exerted here and there over the lateral swinging of the stream through the opening up of previously buried rock-ledges. The effects of uplift on the formation of terraces and rock-platforms are duly considered.

A MEMOIR on the geology of Lower Strathspey, by Mr. L. W. Hinxman and Mr. J. S. Grant Wilson, has been issued by the Geological Survey. The region described, which is in the counties of Elgin and Banff, is formed mainly of igneous and metamorphic rocks with a considerable area of Old Red Sandstone. The metamorphic rocks include granulitic schistose rocks of the Central Highland or Moine schist type, and various quartzites, schists and limestones with associated igneous rocks, grouped as the Banffshire series. To this series the foliated granites belong, while of later date is the great granite mass of Ben Rinnes and the Convals, which forms the dominant feature of the district. The petrography is dealt with by Dr. Flett. Two divisions of Old Red Sandstone are noted, the Middle or Orcadian and the Upper, and between these there is unconformity, as the Upper Old Red Sandstone rests on the basal conglomerates of the Orcadian series and extends on to the crystalline schists. Dr. Traquair contributes an interesting note on the general distribution of fishes in the Old Red Sandstone, observing that there are "three distinct fish-faunæ," while Mr. Kidston, in a note on the fossil plants, remarks that they also show a clearly defined threefold division of this formation. Glacial drifts extend over much of the ground, with the exception of the higher hill tops, and they present many features of interest.

A SUPPLEMENTARY list of lantern slides, recently issued by Messrs. Newton and Co., contains particulars of many slides of scientific interest. Among the subjects of slides suitable for science lectures or lessons are British reptiles and other animals, photographed from life by Mr. D. English; butterflies and moths; trees and plants; photographs of ripples on mercury and water, by Dr. J. H. Vincent; sound waves, by Prof. R. W. Wood; and photomicrographs by Dr. Spitta to illustrate the morphology of the malarial parasite.

IN the November number of the *Field Naturalist's Quarterly*, Dr. G. Leighton reopens the question of adders swallowing their young. Although he is unable to cite any definite instance of the occurrence of the phenomenon, he shows that some of the objections which have been urged against it are based on a misinterpretation of anatomical facts, and demonstrates that there is nothing inherently impossible in its taking place. As the gullet of an adder is perfectly capable of containing the body of a field-mouse, and as frogs are known to live for a considerable time after being swallowed by snakes, there is no reason why young adders should not be swallowed by their parent without being killed. The question remains, however, to be proved by positive evidence. "Of the possibility of the phenomenon," writes the author, "we have not the slightest doubt, of the probability of it we have considerable doubt."

WE have received from the publisher, Herr G. Fischer, of Jena, an interesting pamphlet by Prof. Max Weber, of Amsterdam, entitled "The Indo-Australian Archipelago and the

History of its Fauna." In a previous essay, the author has adduced evidence to show that Celebes should be referred to the Oriental rather than to the Australasian region, the Moluccan Channel, and not the Macassar Strait, forming the division between the two areas. In the present communication, he endorses the opinion that marsupials and monotremes reached Australasia from Asia. According to the author's view, in pre-Tertiary—very likely Cretaceous—times Australia was united by land with Asia. A Euro-Asiatic fauna inhabited this land, from which during the Eocene a southern portion was cut off by partial submergence, this southern portion being the modern Australia and New Guinea, the home of monotremes, marsupials and ancient forms of other groups, such as cassowaries and birds-of-paradise, while widely distributed specialised types are wanting. Northwards extended a coral-sea, in the islands of which dwelt primitive rodents, insectivores and other ancient groups, with perhaps cuscuses. During the Miocene, great changes of level took place in the Archipelago, which attained its present form in the Pleistocene. Celebes was insulated early, Java late. Intermittent land-connections took place, which allowed of periodical immigrations of Asiatic forms from one side and of Australian types from the other. The question is left undecided whether the cuscuses of the Austro-Malay islands are remnants of the primitive Euro-Asiatic fauna or later immigrants from Australia. The suggestion is also made that the Australian and Philippine rodents are relicts of the original pre-Tertiary fauna, although it is admitted that the specialisation of Hydromys is against this. The author fails to see any evidence in favour of a former connection of Australasia with either South America or Antarctica.

THE Rev. George Grenfell, of the Baptist Missionary Society, has constructed a map of the Congo River between Leopoldville and Stanley Falls from running surveys made during 1884–89 in the steamers *Peace* and *Goodwill*. The map is in ten sections, two on a sheet, and the five sheets are published in a convenient case by the Royal Geographical Society. A reprint of Mr. Grenfell's article, "The Upper Congo as a Waterway," which was printed in the *Geographical Journal* for November, 1902, accompanies the map and serves the purpose of explanatory notes.

THE "Englishwoman's Year Book and Directory, 1903," shows in a most convincing manner the ever-increasing part that women are taking in the work of the world. The editor has again obtained able assistance in the preparation of many of the sections, those dealing with science, medicine and education being typical instances. The original work in science done by women workers, a list of colleges where women may study, the names of women holding college appointments, and a list of scientific societies of which women may be members, are some of the subjects included in the science section.

THE issue for 1903 of the well-known annual biographical dictionary, "Who's Who," is considerably larger than previous editions, though all the preliminary tables which have appeared in former years have been removed, except that enumerating the members of the Royal family and the obituary for the year ending September 30, 1902. As usual, prominence is given to the biographies of men who have distinguished themselves in various branches of science, whether pure or applied, and the information is generally trustworthy as well as interesting. The annual is one of the few which can justly be termed indispensable books of reference.

A TRANSLATION, by Prof. J. D. Everett, F.R.S., and Miss Alice Everett, of Dr. H. Hovestadt's "Jena Glass and its Scientific and Industrial Applications," which was reviewed in our issue for December 20, 1900, has been published by Messrs. Macmillan and Co., Ltd., at 15*s*. net. With a view to make the book as clear as possible to English readers, the translators have given the spirit rather than the letter of the original, and they have, in cases where it seemed desirable, added brief explanations, which are always distinguished from the text. Some few matters of subordinate interest have been condensed. The details of an important application of science to industry will, by the aid of this translation, now be accessible to British students and opticians unfamiliar with the German language.

THE permanent seismological commission appointed two years ago by the Imperial Academy of Sciences of St. Petersburg has recently issued its first report, a quarto volume of more than two hundred pages. Most of the papers are written in Russian, and only one of these is accompanied by a summary in French. Several communications deal with the foundation of the International Association of Seismology at Strassburg in 1901; in others, Prof. Lewitski describes experiments with simple seismoscopes and with seismographs the movements of which are registered mechanically. The president of the commission considers the theory of the horizontal pendulum and Mr. B. Galitzin that of other seismographs, the latter erroneously attributing Darwin's bifilar pendulum to Davison. General Pomerantzeff contributes an examination of the seismogram traced at Strassburg on June 24 1901, and concludes that it is extremely difficult to explain the oscillations of horizontal pendulums during earthquakes either by tilts of the ground or by horizontal displacements alone, although they might be produced by a combination of such movements.

A SPECIAL report on the mineral waters of Kansas has been made by Mr. E. H. S. Bailey, with the assistance of Messrs. E. B. Knerr, Crane and McFarland, for the University Geological Survey of Kansas, which is conducted under the authority of the Board of Regents of the University of Kansas. The volume runs to 343 pp. and is divided into two parts; the former provides a discussion of the subject of mineral waters in general, while the latter arranges and classifies those of Kansas and supplies full analyses of a great number of samples of them. Many illustrations and one or two maps add to the value and interest of the report.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *d*.—Herr M. Ebell has calculated the following elements for this comet from observations made on December 3 (Königsberg), December 5 (Hamburg, two observations) and December 7 (Heidelberg):—

T = 1903 April 19·441 Berlin M.T.

$$\left.\begin{aligned} \omega &= 51^\circ\ 51'\cdot2 \\ \Omega &= 112\ \ 54\cdot9 \\ i &= 42\ \ 10\cdot5 \\ \log q &= 0\cdot17344 \end{aligned}\right\} 1902$$

The ephemeris which accompanies these elements estimates that the brightness of the comet on December 31 will be 2·4, its brightness on December 2 being taken as unity.

THE ALGOL VARIABLE R.V. (13, 1902) LYRÆ.—In *Circular* No. 66 of the Harvard College Observatory, Prof. Pickering gives the results of an examination of some of the Draper memorial photographs in regard to the new Algol variable, R.V. Lyræ, recently discovered by Mr. Stanley Williams. From a photograph taken July 11d. 18h. om., 1893, a correction of +4h. or −2h. to Mr. Williams's ephemeris is obtained, but which of these values is the right one Prof. Pickering has not yet been able to determine.

PROPER MOTION AND PARALLAX OF NOVA PERSEI.—In the *Astronomische Nachrichten* (No. 3834), Herr Asten Bergstrand details the observations he has made in order to determine the proper motion and the parallax of Nova Persei.

Using the astrographic refractors of the Upsala Observatory, Herr Bergstrand has obtained eighteen negatives of the Nova

region, and from ninety-five measurements of these negatives he has obtained the following values for the relative yearly motion of the Nova in regard to the comparison stars here given :—

Comparison Star.	Relative yearly motion of Nova. In R.A.	In Decl.
	"	"
a (B.D. + 43 730)	+0·06	±0·05
b (B.D. + 43·732)	−0·07	±0·07
c (B.D. + 43·748)	0·00	±0·07
d (B.D. + 43·751)	+0·10	±0·02

Herr Bergstrand has obtained $+0''.033$ as the final value for the absolute parallax of the Nova.

STAR WITH PROBABLE LARGE PROPER MOTION.—In making observations of Comet 1902 *b*, M. J. Pidoux, of Geneva, has found the position of the star B.D. $-1^{\circ}.3359$, relative to the position of the star B.D. $-1^{\circ}.3360$, to be $\Delta\alpha = -0s.\cdot03$ and $\Delta\delta = 10' \; 33''.6$. In the catalogue for 1855, these values are given as $-2s.\cdot4$ and $-12'.1$ respectively, thus showing—if the observations of M. Pidoux are confirmed —that the star has a large proper motion (*Astronomische Nachrichten*, No. 3834).

REPORT OF THE GOVERNMENT ASTRONOMER FOR NATAL, 1901.—This report deals with all the meteorological data collected during 1901 at the Government Observatory at Durban and at the thirty subsidiary meteorological stations which are scattered throughout the colony.

The equipment of the observatory has undergone no change during the year.

The table giving the yearly rainfall shows that the amount of rain which fell at Durban during 1901 was considerably above the average, being more than double the quantity recorded during 1900.

TOTAL ECLIPSE OF THE MOON, APRIL 22, 1902.—Several series of observations of this eclipse are recorded in this month's *Bulletin de la Société Astronomique de France*, and an excellent coloured plate, showing the appearance of the moon at various phases of the eclipse as seen by Dr. W. van der Gracht, of Graz (Styria), accompanies the observations made by him.

THE GREAT IRRIGATION DAM AT ASSUAN.

THE country of Egypt consisted principally in its natural state of level, arid plains with a few patches of vegetation on the higher parts. Its agricultural prosperity depends entirely on the irrigation derived from the River Nile. It is many thousands of years ago that the first attempt was made to regulate this river and make it serviceable to mankind. In the time of Menes, the west side of the river was embanked, and the water led by a system of canals and embankments to the land lying between the river and the Libyan mountains. When the river was in flood, openings were cut in the banks and the country converted into a series of lakes, the land being enriched and rendered fertile by the warp brought down in suspension by the turbid water of the river. When the floods subsided, the water drained off and the openings made in the banks were again filled up.

This system remained in existence until after the English occupation, when regulating sluices took the place of the more primitive method of cutting and making good the banks. A great depression on the Libyan side of the river was also, in the time of the Pharaohs, converted into a vast regulating basin known as Lake Mœris which was reckoned one of the wonders of the world. Afterwards the right side of the river was also embanked, and the channel enlarged and regulated.

To Joseph of scripture fame belongs the merit of having made one of the principal canals used for irrigating the land, and after the lapse of 4000 years the Bahr Usuf, or Joseph's waterway, is still doing useful work.

For records of further works of importance, it is necessary to skip over a very long period to the time of Mehemet Ali, about the year 1833, who, under the advice of French engineers, caused to be constructed the great barrage above Cairo across the Rosetta and Damietta branches of the Nile, and, by thus holding up the water when plentiful, a very large area of land is irrigated and rendered highly fertile during the dry period. When the difficulty and cost of obtaining the stone necessary for this great work was pointed out to the Egyptian ruler, it is said he at once gave orders for the destruction of so many of the pyramids as would provide the necessary material, and these monuments were only preserved by the engineers assuring the Khedive that the cost of this would be greater than transporting the stone from other places. Until the English occupation, this barrage was more or less a failure, as, owing to defective foundations, the water could not be held up sufficiently high to make the irrigation effective as it otherwise would be. When the English Irrigation Department obtained control over the works, this defect was with great skill and difficulty remedied.

It has long been recognised by the English irrigation engineers that the present system of irrigation very imperfectly makes use of the fertile properties of the Nile floods. The most perfectly irrigated lands command a rent equal to 5*l*. an acre ; imperfectly irrigated land is not worth more than 1*l*. an acre, while one-third of Egypt, or about two million acres, is yet undeveloped. It is estimated that the rental value of Egypt may be increased six millions a year by an effective system of irrigation. The great bulk of the land is dealt with by the original plan of basin irrigation, where the water is carried on to the land during the Nile floods and after remaining there for about six weeks is drained off. The more effective and profitable plan is where perennial irrigation is carried on, that is, where water can be supplied, not only in times of flood, but in summer and dry seasons. To effect this it becomes necessary to store up the water in floods in impounding reservoirs and let it out as required in the dry season.

The great dam at Assuan, which was opened with much ceremony in the presence of the Duke and Duchess of Connaught and the Khedive at the beginning of December, has been constructed for this purpose. This dam, erected across the Nile, will hold up the water for a distance of 147 miles.

For several years, the staff of the English Irrigation Department was engaged in surveying the country in order to arrive at the best site for the intended reservoir, and finally it was decided that the first cataract at Assuan offered the most eligible conditions for this purpose. A scheme designed by Mr. Wilcocks, the chief of the Engineering Department, was approved. This scheme was opposed because the Temple of Philæ would be submerged, and ultimately, in deference to the objections of archæologists and the foreign members of the International Commission who had to be consulted, a compromise was arrived at and the height of the dam was reduced, allowing the temple to stand out above the level of the water. The dam has, however, been so designed that at any future time the additional height can be added to it so as to take full advantage of the natural reservoir capacity. When this is done, ten millions of rental will be added to the resources of the country at a cost of about a quarter of a million a money.

The great dam is a Cyclopæan work. It is a mile and a quarter long, constructed of solid granite and cement, and is founded on the natural bed of granite over which the river runs. The height is 82 feet, and when full it will have a head of 65 feet of water against it. The base is 80 feet and the top 24 feet wide. It is pierced by 140 lower openings 23½ feet high by 6 feet wide, and 40 upper openings. These openings are provided by doors so hung and balanced that they can be lifted and lowered with very little labour. Through these openings, the Nile water will flow in floods and the scour will carry with it the sediment that may have settled when the water is still. As the flood waters decrease, the doors will be closed and the water impounded and only allowed to escape in such quantities as will be required for irrigation during the summer months. For the navigation, a canal a mile long has been cut through the rocks with a width of 50 feet, and a lock constructed having a descent of 69 feet in four drops.

For the further regulation of the water, another dam has been constructed across the Nile 330 miles lower down, above the entrance to the Ibrahimeh Canal at Assiout, to control the irrigation below this point. Here also a lock has been made of sufficient size to allow the largest steamers using the Nile to pass through.

When this scheme of irrigation was ripe for commencement, a question arose as to how the large sum of money required for its execution were to be raised. The International Commission charged with the finances of Egypt refused to allow a charge to be made on the public debt, and without this per-

mission the resources of Egypt were not equal to finding the money. In these circumstances, English enterprise came to the rescue. Sir Ernest Cassel, backed by a financial syndicate, undertook to find the money and Sir John Aird contracted to carry out the work. The capital fund is to be repaid by instalments of 166,000*l.* extending over thirty years, and it is anticipated that the irrigation will produce a revenue of 400,000*l.* a year. Sir Benjamin Baker has been the consulting engineer, and the work was carried out under the direction of Mr. Fitzmaurice, lately appointed engineer of the London County Council. The dam has thus been entirely carried out by English enterprise and English capital.

THE VELOCITY OF PROPAGATION OF X-RAYS.

M. R. BLONDLOT has recently made an experimental determination of the velocity of propagation of X-rays, as a result of which he finds that they travel with the same velocity as light. The full account of the work is published in the *Comptes rendus* for October 27 and November 3 and 10 (vol. cxxxv. pp. 666, 721 and 763), and a translation of the first two papers is given in the *Electrician* for November 21. As the subject is one of great importance, the following brief abstract of the methods used and the results obtained may be of interest to the readers of NATURE.

The method is based on a principle similar to that of Römer's method of determining the velocity of light. The arrangement of the apparatus is shown diagrammatically in Fig. 1. B and B′

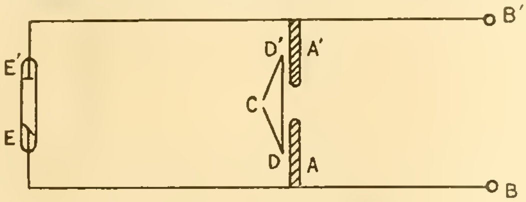

FIG. 1.—Diagram of M. Blondlot's apparatus.

represent the terminals of the secondary of an induction coil which are connected to the poles A, A′ of a Hertz radiator and to the electrodes E, E′ of an X-ray tube. Beneath the Hertz radiator is placed a resonator consisting of a copper wire folded into the shape of a triangle DD′C. The spark gap, C, of this resonator is so placed that it receives the X-rays from the focus tube, but is protected from all other radiation by screens of black paper and an aluminium plate. The oscillator AA′ consists of two brass cylinders arranged horizontally in a bottle of vaseline oil. By suitably altering the length of the spark gap, the oscillator and the focus tube can be made to work simultaneously. The action is then as follows:—At each current of break, the potential between E and E′ rises sufficiently for the X-ray tube to respond. As the potential continues to rise, a spark passes in the oscillator, and this, withdrawing energy from the focus tube, extinguishes it. By careful adjustment, the spark potential of the exciter can be made only slightly greater than the potential necessary to work the tube, in which case the tube will be extinguished very soon after the beginning of the oscillatory discharge, at the end of a time less than a quarter of the period of the radiator. The electric force at the resonator gap only reaches its maximum after a time equal to half the period of the oscillator; hence if the X-ray tube is close to the gap, the X-rays having been extinguished prior to this, there can be no action of the tube on the secondary spark. This conclusion is verified by interposing a sheet of lead between tube and gap, when it is found that the spark is not affected.

Now let the focus tube be kept in the same position and the wires AE and A′E′ be lengthened each by the same amount. This has the effect of delaying the extinction of the tube by the time required for the Hertzian waves to traverse this extra length of wire, and consequently the disappearance of the X-rays at the spark gap C is delayed by the same amount. The X-rays can, therefore, act upon the spark, and that they do so is shown by the fact that the interposition of a lead sheet now makes the spark less bright. If, on the other hand, the wires AE and A′E′ are kept of constant length and the tube moved farther away from the gap, then the X-rays will experience a retardation equal to the time they take to travel from the tube to the gap. The effect of moving the tube farther off should, therefore, be the same as that of lengthening the wires, and this is again confirmed by experiment; the spark grows brighter as the tube is moved away, but if a lead sheet be interposed, the brightness is unaffected by moving the tube. For a certain distance between tube and gap, the X-rays will have at the gap their full intensity during the whole of the time the potential at the gap has an appreciable value; at this point their effect is a maximum, for increasing the distance diminishes their intensity without increasing the time during which they and the electric force act together at the gap. This position of maximum can be found by experiment.

Let V and V′ be the rates of propagation in centimetres per second of the Hertzian waves and the X-rays respectively, and after determining the position of the tube giving the maximum spark when the connecting wires AE and A′E′ are of given length, let these wires be lengthened by α cm. The cessation of X-rays at the gap is thus retarded by α/V seconds. In order to re-establish the coincidence of the times and to find the new maximum, the tube must be moved nearer to the gap by a length β cm., such that $\beta/V' = \alpha/V$. The experiment gives β/α, and therefore V'/V. The following table gives the results of a series of experiments, the first column giving the values of α, the second and third columns the values of β as determined by M. Blondlot himself and his assistant, M. Virtz, respectively, and the fourth column the mean of these two values. Each of the numbers in columns 2 and 3 is the mean of five determinations.

α	β		
	Blondlot.	Virtz.	Mean.
− 7	− 5·9	− 6·5	− 6·2
9	10·5	8·9	9·7
12·5	12	12·6	12·3
15	15·1	14·5	14·8
25	25·3	24·5	24·9
30	31	30	30·5
40	39·3	39·6	39·4
25	24·6	23·2	23·9

The mean result of all the experiments in this and other series gives the value 0·97 for the ratio V'/V.

A variation of the method was also tried in which the ends of the resonator were separated by 0·3 cm., and two wires soldered to them and connected to a micrometer spark gap. These wires were bent back on themselves so as to bring the new gap into the same position as the old one. The Hertz waves have to traverse these wires before producing the spark, and if each wire is lengthened by a cm., the spark is retarded by a/V seconds. To obtain the new maximum, the tube must be moved away from the gap by a distance b cm. such that $b/V' = a/V$. A number of very concordant experiments by this method gave a mean value 0·93 for the ratio V'/V.

The final result of all the experiments, therefore, leads to the conclusion that *the velocity of propagation of X-rays is equal to that of Hertzian waves or of light through the air.* M. Blondlot concludes his papers by pointing out that this conclusion is in harmony either with the hypothesis that X-rays are radiations of very short wave-length or with that of E. Wiechert and Sir George Stokes, that they are electromagnetic impulses produced by the impact between the molecules or electrons in the kathode stream and the antikathode. The fact brought out by these experiments that the X-rays cease simultaneously with the current traversing the Crookes' tube, also supports the latter hypothesis.

MAURICE SOLOMON.

RECENT DIETARY STUDIES.

THE character of the daily menu is influenced by various considerations, but it will be universally conceded that the idiosyncrasies of the palate play the predominant part, and to suggest to the ordinary housekeeper that scientific principles should be allowed a voice in the determination of our diet would be simply to court ridicule, for of all departments of the household the kitchen is probably the most conservative in its customs and the most dominated by habit and tradition. It will not be

the fault of our Transatlantic cousins, however, if the reign of ignorance and indifference in this department of domestic life be permitted to continue, for the United States Board of Agriculture has recently published a series of bulletins or reports on the dietetic value of food stuffs of various kinds, embodying also the results of dietary studies on individuals carried out in all parts of the country.

These studies have not been confined to a particular class of persons, but have been undertaken in connection with the well-to-do as well as with the very poor, and embrace people engaged in hard physical work as well as those whose occupation is more sedentary in character; in fact, the common labourer and the average professional man are both represented in the types selected.

Of particular interest are the studies recorded of the dietary habits of the Chinese, for tradition assigns to this race the highest attainment in the art of producing from a given area the maximum amount of food material. This success is due firstly to a much more "intense" cultivation of the land than is customary in the western hemisphere, and secondly to the utilisation of a great variety of food plants, many of which are quite foreign to our culinary arts, but the employment of which enables the Chinaman to exploit every kind of soil and climate and compel it to yield up its quota of food material.

Thus a European visiting the Chinese market of San Francisco would have some difficulty in realising that the wares displayed were for culinary purposes, for amongst other garden plants he sees costly lily roots which he has been in the habit of importing at a high price with which to adorn his conservatories, here offered for sale as an attractive addition to the diner's menu. Many varieties of lily bulbs are eaten both by the Japanese and Chinese, but that principally on offer in the San Francisco Chinese market is the *L. brownii*. They are regarded as a delicacy and an especially desirable food for invalids, and are usually eaten but slightly cooked and with the addition of sugar. Chemical analysis shows the albuminoids present to be distinctly greater than in potatoes, but the most important constituent of the bulbs is starch, which is present in sufficient amount to endow them with a high nutritive value as a food stuff. But not only are the bulbs of lilies eaten; the dried flowers of the lovely day lily, *Hemerocallis fulva*, so sought after by all lovers of gardens on account of its rich colour and wealth of blossom, are largely used and highly prized by the Chinese as a flavouring ingredient. This article is sold under the name of "Kam cham t'soi" or the "gold-needle vegetable," and it has been found to possess a not inconsiderable nutritive value, besides being an attractive condiment.

Space does not permit of a reference to all the numerous and, to our ideas, strange articles which a Chinaman draws upon for dietetic purposes, but some mention must be made of the plant which both tradition and art have from time immemorial endowed with such a full measure of religious and classical associations.

To those of us who associate the *Nelumbium speciosum* of the botanist with the "mild-eyed, melancholy lotus eater," of the poet "whose voice was thin as voices from the grave," whilst "deep asleep he seemed yet all awake," the extensive economic use to which the lotus plant is put comes as a surprise. Whilst sought after on account of its surpassing beauty and grown in some parts in great vases placed at the doors of the houses, its more material applications are both numerous and varied. Thus we read, in a report published by Jules Grisard in 1896, that the stamens are used in China as an astringent remedy and also for the toilet; the petioles and peduncles furnish a viscous sap employed in India as a remedy for vomiting and diarrhœa; the fibro-vascular bundles of the petioles are made into lamp wicks, and the carpophore furnish a popular remedy for blood spitting. The seeds are eaten either raw, boiled or roasted, much as we use chestnuts, but the dark green germ is very bitter and is removed before use, and has given rise to the Chinese saying "bitter as the plumule of the lotus seed." A kind of bread is made of the seeds in Egypt, whilst they are also used as a remedy for indigestion, &c. Starch is extracted from the roots which is highly prized for its reputed strengthening properties; but this does not by any means exhaust all the virtues attributed to this wonderful plant. The Chinese materia medica, however, is said to present too many incongruities to permit of implicit reliance being placed upon the numerous medicinal properties associated with it, but the roots are on sale in considerable quantities, Mr Blasdale informs us in his report, throughout the winter and early spring months in the Chinese market of San Francisco.

It is popularly supposed that the Chinese live almost entirely upon rice and that their diet is limited in amount, the apostles of vegetarianism not infrequently quoting the Chinaman as an example of how large an amount of hard work can be accomplished on a vegetarian diet. Studies, however, made in the Chinese quarter of San Francisco[1] do not support this theory, but show that whilst much more varied than that of an American or European, the Chinese diet is neither scanty in amount nor inferior in nutritive quality, whilst it is decidedly more varied and far cheaper than that of the former.

Thus, in the dietary study of a Chinese dentist's family living in comfortable circumstances and fairly typical of the average Chinese professional man, it was found that whilst the total amount of nutrient actually consumed per man per day agreed very closely with that suggested, as the result of inquiry, as a standard for a man engaged upon light muscular work, viz. 112 grams protein and 3150 calories of energy, the cost per man per day in the case of the Chinaman's family was about 50 per cent. less than that which experience has shown to be the average expenditure in the family of a professional man of the same position in the United States.

On inquiring more closely into the nature of the diet of this Chinese family, we find that as regards the source of animal protein pork took the first place, supplying nearly one-third of the total; fish comes next, followed by chicken, and last on the list is beef. The main vegetable food was rice, but considerable quantities of bread and other cereal products were also used, and a large amount of cheap green vegetables, the greater part of the latter being Chinese varieties. Amongst the unfamiliar articles of food recorded were dried crabs, dried shrimps, dried radishes, taro root, bean sprouts, bean cheese, dried fungus, lily petals, algæ, bamboo shoots and the leprosy gourd. Tea and coffee were used as beverages, and the daily expenditure per head for these was 0·5 cent.

Dietary studies of Chinese engaged upon hard physical labour such as prevails on a Chinese truck farm or vegetable garden, again, showed that the diet adopted furnished very nearly the amount of animal protein and calories of energy commonly accepted as the standard of that required by a man in active work, *i.e.* 150 grams protein and 4500 calories. In this case also the diet was very varied, and we find included among the peculiarly Chinese articles of food water-lily roots, dried lily flowers, water chestnuts, bean cheese, dried fungus, &c. The cost per head per day was 19·7 cents, and Prof. Jaffa, who furnishes the report on these Chinese diet studies, says that as regards the Chinaman's capability for work there is no question: "few Americans could walk as he does for hours at a stretch, often up and down hill, burdened with a load of from 300 to 400 pounds in the baskets which he carries suspended by ropes to a pole balanced across one shoulder, whilst in adverse circumstances, such as long hours, great heat or exposure to cold and dampness, a Chinaman can not only do more work, but can stand the strain better than a strong white man."

Let us now turn to some of the dietary studies made in New York city amongst the poorer classes and reported by Messrs. Atwater and Woods. The district selected is described as "one of the worst congested and typical of the portions of the city known as slums," whilst the families selected for dietary study were chosen as representative of the population of the district. The diet of no less than twenty-one different families over a period of ten days was carefully recorded, and the results obtained are of much economic importance, showing that in many cases unwise expenditure is fully as responsible for distress as a too limited income.

As an instance of this the case of a mechanic's family in very poor circumstances may be cited. This family had received a great deal of help from the Association for the Improvement of the Condition of the Poor, and yet it was found that the expenditure on food was nearly twice that per head in the family of a well-to-do professional man, hardly anything being left over from the wages earned for fuel, lights, clothing and the many other requirements of a family. The food consumed furnished at least 25 grams of protein and 600 calories of energy per head in excess of that required by a man at moderate work. Whilst the amount of food purchased could have been reduced 25 to 30 per cent., a more judicious selection of the same and more skill in its preparation would have enabled a

[1] From inquiries it was ascertained that the system of diet adopted by the Chinese in San Francisco differs but little from that of the Chinese in their own country.

large proportion of the money spent on food to have been expended on other things.

What applies to this family applies equally to many of the other families in which dietary studies were carried out, and over and over again we find it stated that more food was purchased than was necessary for efficient nourishment. To each dietary study is appended criticisms of and suggestions for changes and improvement in the diet pursued, and these constitute a valuable addition to the report and form, indeed, an eloquent argument that our school curriculum should provide for the education of children in the elementary principles of diet in relation, not only to the economy of the body, but also to that of the family purse.

The selection of food stuffs on rational or scientific principles does not, perhaps, sound appetising, but the numerous investigations on the nutritive value attaching to substances which have been carried out in America and elsewhere cannot be overlooked, and it is, perhaps, not unreasonable to believe that current notions on diet may become modified in the future, more especially in those cases where on economical grounds reform is so urgently needed. These studies are, therefore, of social as well as scientific importance, and acquire particular significance for the poor at times when taxes shall tell heavily upon their resources.

In conclusion, brief reference may be made to the elaborate experiments which have been carried out on the different degrees of waste entailed in the different methods adopted for the cooking of food of various kinds.

Amongst the names associated with investigations on the loss of nutrients in the cooking of meat, we find that of Thudicum in this country, Vogel and König in Germany, whilst in America the most recent contributions to this subject have been made by Grindley, in conjunction with Messrs. McCormack and Porter. As regards the loss in weight which takes place, various investigators agree in stating it to be from one-fifth to one-third, whether the meat be boiled or roasted. Where beef, for example, is cooked in water, from 3 to 20 per cent. of the total solids is found in the resulting broth, the degree of loss in constituents appearing, to a certain extent, to depend upon the size of the piece of meat employed, the smaller the dimension it is reduced to the greater being the loss; whilst the duration of time of cooking must also be taken into consideration, the more prolonged it is the greater, again, being the loss entailed. The practical lesson to be learnt from the investigations which have so far been made appears to be that the most economical method of cooking meat is to broil it in a frying-pan, for in this manner the least loss of nutrients occurs.

In the case of vegetables, the losses entailed by cooking appear to be even greater than those recorded for meat. Thus as regards carrots, in boiling them nearly one-half of the mineral matters present are lost, together with about 40 per cent. of the total nitrogen and about 26 per cent. of the sugar present.

These percentages of loss or waste may be considerably reduced if the carrot is boiled whole instead of being first cut, as is customary, into small pieces. In this manner the loss in sugar, for example, instead of being 26 per cent., is reduced to very nearly half that amount, and similar economies may be effected in regard to the other constituents of the carrot.

In boiling cabbages the loss is very considerable, from 35 to 40 per cent. of the total nitrogenous matter present being left in the water, which, as everyone knows, is consigned to the kitchen sink as rapidly as possible. The Scotch recipe for making broth, which involves the addition of uncooked cabbage to the stock-pot, besides being justly renowned for the excellent results it produces, has also, therefore, distinct advantages from an economic point of view. As regards potatoes, we cannot do better than follow the custom of cooking them which prevails in the Emerald Isle. The Irish method of boiling potatoes in their skins is not only the most palatable, but also the most economical way of using them, for when potatoes are peeled and then boiled there is a very considerable loss, not only of organic nutrients, but also of the mineral salts present.

The above brief review may help to emphasise the economic importance quite apart from the scientific interest attaching to such investigations, for by indicating, not only the best means of utilising the existing sources of food supply, but also for extending their range, such researches may conceivably contribute not a little to the prosperity of a country as a whole, whilst they can undoubtedly promote the well being and to a certain extent, therefore, the happiness of the individual.

G. C. FRANKLAND.

MAGNETIC OBSERVATIONS IN BADEN.

AN account of a minute magnetic survey of a small district in Baden, adjacent to the Rhine, where there is considerable local magnetic disturbance, has been received from the author.[1] Observations of horizontal force were made at nearly 400 stations, and observations of declination and inclination were made at about 140 of them. The object seems to have been to observe at a large number of stations with moderate accuracy in a short time. In fact, most of the data recorded in the tables on pp. 6–26 seem to have been obtained in the two months August and September of 1898. Horizontal force was observed only to the nearest 0·001 C.G.S., and declination and inclination usually only to the nearest 0°·1. Within the narrow region dealt with—some 150 square kilometres—declination was observed to vary between 3°·7 W. and 20°·8 W., inclination between 56°·6 and 72°·0, and horizontal force between 0·173 and 0·227 C.G.S. In a district so disturbed, it would have been of doubtful advantage to have employed superior instruments, giving a higher order of accuracy than that actually aimed at. The results are embodied in four charts, which give respectively the lines of equal horizontal force, the isoclinals, the isogonals, and particulars of the horizontal and vertical components of the disturbing force system. The chief conclusions appear on p. 39. The most interesting of them is that the basaltic rocks—using *basaltic* in a general sense—which form the chief hills in the district, behave mostly like vertical magnets with their north poles uppermost. Their magnetisation is thus *opposite* to what it would be if induced under the action of the earth's own field. The phenomena thus differ in a remarkable way from those observed by Rücker and Thorpe in the United Kingdom. A second somewhat interesting deduction from the observations is that there is an extension of underground basaltic masses beneath part of the level country adjacent to the Rhine near Breisach, where local disturbances would not have been anticipated from the superficial appearance of the country. The author also gives the results obtained from taking a line integral of the horizontal magnetic force round the whole district and round four subdivisions. With the exception of one of the smaller subdivisions, the departure of the line integrals from zero is very small. This may be regarded as evidence of the accuracy of the observations, if we assume that the magnetic forces are derivable from a potential, which can hardly fail to be the case so far as concerns the field answering to the local disturbances. C. C.

THE ORIGIN OF THE THOROUGHBRED HORSE.[2]

THE author said that he had shown (*Academy*, January, 1891, p. 91) that not only, as had been long observed, did the Homeric Greeks drive the horse before they rode him, but that the same was true of all ancient peoples—Egyptians, Canaanites, Assyrians, Aryans of Rig-Veda, Umbrians, Celts—and that the explanation of this was given by Herodotus (v. 9), who, in speaking of the Sigynnæ, the only tribe north of the Danube, whose name he knew, said that they had small horses, with large flat noses and very long hair, which, though not able to carry a man, were excellent under chariots: "wherefore they used chariots." Dio Cassius likewise says that the Britons used chariots in war, because their horses were "small though active." The description of the horses of the Sigynnæ tallies exactly with the abundant remains of the primitive horse of Europe, eaten in great quantities and delineated on antlers by the men of the Stone Age. He was a small animal about 10 hands high with a big head. Even after domestication he remained very small, as witness bits of bronze and horn found in Swiss lake dwellings, the shoes found at Silchester, and in camps on the Roman Wall, &c. Authorities are agreed that from this primitive horse has been developed the cart horses of the continent and these islands, whilst our blood horses have come from an eastern stock of slight build and smart appearance. Our problem is to ascertain the original habitat of this superior horse. He has not come from upper Asia, as the Mongolian pony is taken as the type of the coarse, thickset horse from which sprang the cart horse. The Mongolian pony probably

[1] "Erdmagnetische Untersuchungen im Kaiserstuhl." Von Dr. G. Meyer. Mit 4 Karten. (Separatabdruck aus den Berichten der Naturforschenden Gesellschaft zu Freiburg i. B. Bd. xii., 1902.)

[2] Abstract of paper read before the Cambridge Philosophical Society on November 24, by Prof. Ridgeway.

represents the Scythian horses, which continued to be of a small size down to Strabo's time, and they were derived either from he tarpan or Prezevalsky's horse. The Mongolian pony, though surefooted and enduring, is slow of pace. Neither China, Siam nor Burmah have any indigenous horse answering to the blood horse. India could never breed horses, says Marco Polo, in whose time India was supplied either with Mongolian ponies from Yunnan or with Arabs from south Persia, Aden and other Arabian ports. These Arabs fetched enormous prices, equivalent to 200*l.* It has hitherto been universally held that Arabia is the original home of the blood horse. This is a baseless assumption. In the Old Testament, the Arabs are never mentioned as riding anything but camels and asses. Though the author of Job knew of the war horse, yet Job did not own a single horse, his equine possessions consisting of 500 she asses. Herodotus (vii. 87) enumerates the nations (including the Libyans) that supplied cavalry to Xerxes' host, but the Arabs only furnish a camel corps. Agatharchides (cited by Strabo) describes the Arabs as camel keepers.

Finally, Strabo (*flor.* A.D. 1) expressly states that neither the peoples of Arabia Felix nor those of Arabia Petræa bred horses. Naturally, then, Scaurus after defeating the Arab king Aretas put on his coins Aretas leading his camel. It is clear, then, that down to the Christian era the Arabs bred no horses. It is therefore clear that though the Persian kings in the fifth century B.C. bred the largest and best horses in Asia, these were not of an Arab strain. These horses were kept largely in Armenia, and are described by Strabo as similar to the Parthian horses, and as differing from the horses bred in Greece and the other kinds of horses known in the Roman empire. There can be little doubt that they were the same horses as Marco Polo found in great numbers in Armenia (1270 A.D.) known as Turquans, the Turcoman ponies well known in Persia to-day. The Persian horses cannot, then, have been the ancestors of the thoroughbred, though it is quite possible that their superiority was due to their having a cross of thoroughbred blood, for already by 900 B.C. Solomon imported horses from Egypt (1 Kings x.), and "so for all the kings of Syria and for all the kings of the Hittites" Egypt could not breed horses, neither could she have got them from the Arabs, who bred none even 1000 years later. But she could and did get them from the Libyans, who from the dawn of history are masters of the most famous horses. Cyrene sent the best horses to the games of Greece (Pindar, *Pyth.* iv., &c.). It is noteworthy that it was in the same century as the founding of Cyrene that the four-horse chariot and the racehorse were added to the Olympic events. The Phœnician settlers at Carthage found the Libyans using these beautiful horses, and when they struck coins placed a horse or a horse-head on them as the badge of Libya, and used a similar type on their coins struck in Sicily, whither, doubtless, they carried the Libyan breed. This accounts for the extraordinary fame of the horses of Etna and Syracuse and the famous steeds of Tarentum. It is now clear that the Arabs never owned a good horse until they had become masters of North Africa and the Barbary horses, from whom are sprung our own racing stock through Lord Godolphin's Barb. North Africa, therefore, and not Arabia or any other part of Asia is the original home of the thoroughbred.

Now, though the pedigree of the cart-horse type can be traced to the coarse, thickset little horses of Europe and Asia, the wild ancestor of the Barb is yet to seek, for Africa has no wild horse, such as tarpan or Prezevalsky's, though she has an ass and four zebras, including the quagga, now extinct. Can the Barb be sprung wholly or in part from a zebra? Arab foals at birth constantly have zebra markings, sometimes retained when full grown, as by Prof. Ewart's Arab filly Fatima. Strabo, too, notices that the horses of the Libyan Garamantes have longer hoofs than any other horses. Prof. Ewart's hybrids from Burchell's zebra and various mares show the markings, not of a Burchell's zebra, but of a Somaliland zebra, from which it has been inferred that the remote ancestor of both *Equus caballus* and Burchell's zebra was striped like the Somaliland and mountain zebra. But is it necessary to go back so far? May not the Somaliland zebra stripes in the hybrid be due to the circumstance that the dam in each case had a certain amount of Barb blood in her, which was derived from either the Somaliland zebra or a closely allied species? He (Prof. Ridgeway) had crossed a Muscovy drake with a common white duck, derived from the common wild duck, with the result that all the offspring are coloured, and their colouring resembles that of the mallard. No one would say that the hybrids show a reversion to a remote common ancestor of both mallard and Muscovy, for it is obvious that the colouring is simply that of the white duck's immediate ancestors. Authorities like Captain Hayes have pointed out the great similarity in form between Burchell's and the Somaliland zebra to a well-bred horse, *i.e.* a horse that has Barb blood in him. He therefore suggested that the Barbary horse, from which he had shown all the fine horses of the world have sprung, was derived either from the zebra of north-east Africa or, as is more likely, from some very closely allied species, now extinct, which, like Prezevalsky's horse, may have had castors on its hind legs like *Equus caballus*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. A. S. Green has been appointed professor of dyeing at Yorkshire College, in succession to the late Prof. Hummel.

The University of California is about, says *Science*, to erect a physiological laboratory at a cost of 25,000 dollars. It will be under the charge of Dr. Jacques Loeb.

The royal assent was given to the Education Act, 1902, on Thursday last. The Act comes into operation, except as expressly provided, on March 26, 1903, or such other day, not being more than eighteen months later, as the Board of Education may appoint. The Act does not extend to Scotland or Ireland, or for the present to London.

Bedford College for Women, London, and the Sanitary Institute have in conjunction arranged a conference on the subject of hygiene for schools, to be held at the College on January 21, 1903. Prof. C. S. Sherrington, F.R.S., Dr. Gow, Mr. Michael Sadler, Prof. Adams and others are expected to speak. Further particulars and cards of admission can be obtained either from the Sanitary Institute or from Bedford College.

The special committee appointed to consider the needs of South Africa in regard to technical education, with special reference to the Transvaal, have, says the *Chemist and Druggist*, submitted a lengthy report, and state they are convinced that there is a great demand, especially in Johannesburg, for technical education. This demand can best be met, in their opinion, by establishing an institution providing the highest kind of training in arts and sciences. They recommend that all students, before admission to the institution, pass an examination of a standard equal to the matriculation of the Cape University. Complete courses should be provided in the new institution, the committee think, in mining, mechanical and electrical engineering, metallurgy and chemical engineering, civil and sanitary engineering, and architecture.

In his paper on French rural education, read before the Society of Arts on December 10, Mr. Cloudesley Brereton explained the part taken by the primary and secondary schools in the agricultural education of the nation. In France, in some communes, one person in every four is a land proprietor, and the aim in the primary schools has been to give the pupil some grasp of the principles underlying the science of agriculture. The teacher is not so much supposed to follow implicitly the departmental programme, but rather to choose those portions which best suit his own particular district. There is still doubt in the minds of French educational authorities whether the scientific or the agricultural side of the instruction should predominate in the instruction given in primary schools. The teachers in these schools are themselves trained by professors of agriculture in the training colleges, and though the course of instruction is a good one, it might with advantage be more practical. In the secondary schools of France, agricultural education has an insignificant place, but the work done in this direction by means of lectures and evening classes carried on in connection with old boys' clubs and other organisations is very great.

An important article, by Mr. W. M. Webb, on the progress and interpretation of "nature-knowledge," especially in relation to the experience gained at the Nature-Study Exhibition held last August in London, appears in the October issue of the *Record of Technical and Secondary Education*. After referring

to the importance of nature-study as a factor in the new education, the author insists on its value as a means of cultivating the powers of observation and at the same time warns his readers that it is not to be considered as in any way identical with elementary science. Various definitions and limitations of the subject are then given, after which attention is directed to its aims and objects. Among these, stress is laid on its power of interesting pupils—especially those to whom the ordinary school-curriculum is peculiarly distasteful—and thus rendering education a pleasure rather than a toil. It is also urged that nature-study promises to be the form of education best adapted to develop the pupils into good citizens capable of making their way in the world and, above all, of relying on their own judgment. Healthful it certainly is, and the love of nature it engenders may, it is suggested, tend to check the exodus of the population from the country to the towns. The difficulty of securing the right class of teachers claims a considerable share of attention, and some amount of discussion is devoted to the question as to the extent to which books should be used. Collecting, again, is a phase of the subject which requires very careful treatment in order to prevent the pupils from degenerating into mere curiosity-hunters. The author is, however, of opinion that both books and collections have their place in the scheme. The relative values of outdoor and indoor work are then discussed, in the course of which much importance is attached to the "seasonal method" of study. Before the final summary, the article winds up with observations on teachers of all grades and classes, and the best method of training them, followed by a reference to the objections against, and the difficulties connected with, "nature-study."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 27.—"The Inter-relationship of Variola and Vaccinia." By S. Monckton Copeman, M.A., M.D. Cantab., F.R.C.P. Communicated by Lord Lister, F.R.S.

The term "variolæ vaccinæ" employed by Jenner, as a synonym for cow-pox, has been generally accepted as affording evidence that, in so naming this disease "small-pox of the cow," he was desirous of placing on record his belief that cow-pox or vaccinia was intimately related to human small-pox, if indeed it were not directly derived from it.

But the difficulty experienced by the writer and numerous other investigators in attempts to transmit small-pox to bovines, whether cows or calves, has not infrequently been cited as a reason for regarding Jenner's theory with distrust.

It is well known, however, that a great deal, at any rate, of the small-pox which was prevalent at the time that Jenner lived and wrote was of that comparatively mild variety which, under the name of inoculated small-pox, was intentionally produced in healthy subjects, with the object of thereby conferring protection against subsequent attack by the disease in virulent form.

So mild indeed, at times, were the results of inoculations in the hands of such operators as Adams and the brothers Sutton, that, as we learn from contemporary records, in many instances but little obvious effect was observed, with the exception of the local vesicle arising at the site of insertion of the small-pox virus. The majority of persons thus inoculated are not likely, therefore, to have been incapacitated, as the result of the operation, to a much greater extent than are those who undergo efficient vaccination at the present day, and, doubtless, they would be, for the most part, capable of following their ordinary avocations during the progress of the induced disorder.

Not only were the effects following on inoculation comparatively mild, but the disease in this form was intentionally carried into many country districts which otherwise might not have become invaded by small-pox.

In the light of these facts, it would appear not improbable that it was from the *inoculated* form of small-pox rather than from the ordinary variety of the malady that much, at any rate, of the cow-pox in the pre-vaccination era was derived. Supposing this to have been the case, it is not difficult to understand how that the cracks, so often found on the udders of cows, might become infected by a milker with fingers contaminated by contact with the inoculation sore upon his arm.

In default of inoculated small-pox in the human subject, use was made of the monkey, which, as the writer had shown in a previous communication to the Royal Society, is readily susceptible to the disease. The necessary small-pox material has been obtained during the course of recent outbreaks of small-pox at Middlesbrough, Glasgow and London.

The results of the experiments may be briefly summarised as follows:—In each of the separate series, the human small-pox lymph or pulp was first inoculated directly on calves, and in every instance, so far as could be observed, with altogether negative results. But with monkeys, success was as invariably obtained, and when, after one or more passages through this animal, the contents of the local inoculation vesicles were employed for insertion on the calf, an effect was now produced which, after two or three removes in that animal, was indistinguishable from typical vaccinia. Moreover, from the contents of vesicles raised in this manner on the calf, a number of children have been vaccinated, some of whom were afterwards kept under observation for a considerable period. Every such vaccination "took" normally, and in no case was any bad result subsequently observed.

The experimental results obtained all tend, then, to confirm the view that the vaccinia of Jenner's time was derived, in all probability, from a comparatively mild form of small-pox. Of even more importance is the fact that the work has afforded conclusive evidence of the essential identity of the virus of small-pox and cow-pox or vaccinia.

December 4.—"On the Vibrations and Stability of a Gravitating Planet" By J. H. Jeans, B.A., Isaac Newton Student and Fellow of Trinity College, Cambridge. Communicated by Prof. G. H. Darwin, F.R.S.

The first part of the paper deals with the vibrations and stability of a gravitating elastic sphere. The matter is not necessarily homogeneous, but is arranged in spherical layers. It is pointed out that, in the classical investigation of the displacements produced in a gravitating sphere by given surface-forces, the most important of the gravitational terms is omitted. The effect of this omission is to necessitate a correction, and this may entirely invalidate the solution when we are dealing with spheres of the size of the earth or other planets. In fact, it appears that for a gravitating solid of the kind we are discussing the spherical configuration may be one of *unstable equilibrium*, the instability being brought about by these gravitational terms. The vibration through which instability first enters is one in which the displacement at every point is proportional to a harmonic of the *first* order.

In a former paper, "The Stability of a Spherical Nebula" (*Phil. Trans.*, A, vol. cxcix., p. 1), the suggestion was put forward that the instability of a nebula, sun or planet, which, upon the nebular hypothesis, is supposed ultimately to result in the ejection of a satellite, may be largely brought about by a gravitational tendency to instability of the kind described. We take, for the moment, an extreme hypothesis, and imagine that this agency is the preponderating agency and that the rotational tendency to instability may be disregarded in comparison.

Except for the changes which have occurred since the consolidation of the planets, the solar system supplies material for testing the consequences of this hypothesis. When a number of planets of varying masses have thrown off satellites, we find (upon our present extreme hypothesis) that the masses ought to be proportional to the *squares* of the radii. It is found that this law is approximately obeyed in the solar system. It is further found that the absolute values of the masses and radii are approximately such as would be expected.

It is interesting to compare two extreme hypotheses, the first referring the phenomena of planetary evolution solely to rotational, the second solely to gravitational, instability. Given the approximate values of the density and elasticity of a planet, and the fact that this planet has thrown off a satellite, then the former hypothesis leads to a certain inference as to the angular momentum of the system, the latter to an inference as to the radius of the primary. The former leads to no inference at all as to the size of planets which are to be expected—they are as likely to be of the size of billiard balls as of the size of the planets of our system—while the latter leads to no inference as to the angular momentum of the system, but presupposes it to be small. The contention of the present paper is that the inferences which are drawn from the former hypothesis are not borne out by observation on the planets of our system, while those which are drawn from the latter are borne out as closely as could be expected. The true hypothesis must of necessity lie somewhere between the two extremes which are being

compared, but the evidence seems to show that it is much nearer to the latter (gravitational) than to the former (rotational).

We next consider a number of questions connected with the figure of the earth. It seems to be almost certain that the present elastic constants of the earth are such that a state of spherical symmetry would be one of stable equilibrium. On the other hand, if we look backwards through the history of our planet, we probably come to a time when the rigidity was so small that the stable configuration of equilibrium would be unsymmetrical. At this time the earth would be pear-shaped, and the transition to the present approximately spherical form would take place through a series of ruptures. It is suggested that the earth, in spite of this series of ruptures, still retains traces of a pear-shaped configuration. Such a configuration would possess a single axis of symmetry, and this, it is suggested, is an axis which meets the earth's surface somewhere in the neighbourhood of England (or possibly some hundreds of miles to the south-west of England). Starting from England, we find that England is at the centre of a hemisphere which is practically all land; this would be the blunt end of our pear. Bounding the hemisphere we have a great circle, of which England is the pole, and it is over this circle that earthquakes and volcanoes are of most frequent occurrence. Now, if we suppose our pear contracting to a spherical shape, we notice that it would probably be in the neighbourhood of its equator that the changes in curvature and the relative displacements would be greatest, and hence we should expect to find earthquakes and volcanoes in greatest numbers near to this circle. Passing still further from England, we come to a great region of deep seas—the Pacific, South Atlantic and Indian oceans; these may mark the place where the "waist" of the pear occurred. Lastly, we come, almost at the antipodes of England, to the Australian continent. This may mark the remains of the stalk-end of the pear.

Physical Society, December 12.—Mr. S. Lupton, vice-president, in the chair.—Mr. S. W. J. Smith exhibited and described a portable capillary electrometer. This instrument is a modification of the form of capillary electrometer which consists of two wide tubes joined by a cylindrical capillary tube which may be horizontal or inclined. The apparatus contains mercury and sulphuric acid of about maximum conductivity suitably distributed in the tubes. A spring key is commonly used with the instrument, but the author has devised a key consisting of a U-tube closed at one end, communicating at the other with a pneumatic pressure ball and containing mercury in the bend. By squeezing the ball, the same change of contacts can be produced as by pressing the lever of an ordinary spring key. Using this key and a microscope magnifying 50 diameters, a potential difference of 1/10,000th volt can be detected without difficulty. The instrument, used as a surface-tension galvanometer, is more convenient than an ordinary galvanometer with a magnetic system because there is no suspension, no lamp and scale, and practically no levelling.—A paper on astigmatic aberration was read by Mr. R. J. Sowter. This paper affords a simple explanation of some of the shadow phenomena observed by Prof. S. P. Thompson in his experimental researches on the aberration of lenses, namely, in those experiments in which the aberration is wholly or in part astigmatic.—Prof. L. R. Wilberforce exhibited apparatus for a lecture experiment on gaseous diffusion. In Graham's experiments on diffusion through porous septa, the gas experimented upon was contained in a vessel inverted over water, and the pressure was kept approximately atmospheric by applying a counterpoise to the vessel. This adjustment, however, is imperfect owing to the weight of the water displaced by the material of the vessel. Prof. Wilberforce showed that, by suspending the vessel from one arm of a balance rendered suitably unstable by a weight above the central knife-edge, a compensating effect could be introduced and the pressure kept sensibly constant for a considerable range of motion of the vessel. He pointed out that this device could also be utilised for the measurement of pressure.—A paper on vapour-density determinations, by Sir W. Ramsay and Dr. Steele, was read by Sir W. Ramsay. This paper gives a detailed account of some accurate experiments on the densities of vapours over a large range of pressure carried out by a modification of Gay-Lussac's method. This method has the advantage that while densities are being determined, compressibilities can, within certain limits, be simultaneously estimated with the same sample of material. From results of experiments, it appears that the densities of certain compounds calculated for zero pressure are not proportional to their molecular weights deduced from the atomic weights of the elements which they contain. This conclusion involves one, or it may be several, of a series of assumptions enumerated in the paper. These assumptions are fully investigated and discussed, and the authors suggest that it may be possible that the atomic weights of the elements depend on the proportion in which they are present in the compounds which contain them.

Royal Astronomical Society, December 12.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—Mr. Innes presented a paper on some developments in terms of the mean anomaly and also the results of measures of double stars made at the Royal Observatory, Cape of Good Hope, in 1902. He made some remarks on the excellence of the McClean telescope, with which the measures were made, and the great convenience of the rising floor of the observatory.—Mr. Hardcastle read a note on binding together réseaux and plates. In measuring some photographs of the moon, on which no réseau had been impressed, the réseau plate and photograph were bound together film to film, but in the course of measurement a slight shifting occurred, which it was difficult to prevent. —Mr. Bellamy read a note on preserving negatives. Some developed star negatives which had been placed in envelopes and stacked on shelves were found after a time to have received on the film a faint image of the inscription that had been written on the envelopes. Mr. Knobel remarked that this was certainly not due to the effect described by Prof. Russell, as the writing was only visible on the film by reflected light.—The Astronomer Royal exhibited and described a new measuring machine which had been made by Troughton and Simms for the Royal Observatory, Greenwich, and was intended for the measurement of photographs of Eros.—A paper by Mr. Robinson, of the Radcliffe Observatory, Oxford, was read, on the photographic and visual magnitude of α Orionis. Between March 9, 1901, and October 22, 1902, the photographic magnitude of this star had slightly increased, and since the latter date there appeared a gradual decline in brightness; both the increase and decrease were confirmed by the visual estimations.—Photographs of the spectra of Jupiter, Saturn and other planets, taken by Mr. Percival Lowell at Flagstaff, Arizona, were shown on the screen.—Mr. Hinks exhibited photographs of Mr. Ritchey's series of drawings from the negatives of the nebula surrounding Nova Persei taken at the Yerkes Observatory. Mr. Hinks showed by the aid of diagrams how the apparent motion of the nebula might be explained upon the hypothesis of Prof. Kapteyn, that successive portions of the nebula were illuminated by the star and that there was no real motion of the nebula itself.

Mathematical Society, December 11.—Prof. Lamb, president, in the chair.—The following papers were communicated:—Prof. L. E. Dickson, (1) The abstract group simply isomorphic with the group of linear fractional transformations in a Galois field; (2) Generational relations of an abstract simple group of order 4080. The first paper deals with the abstract group of order $\frac{1}{2}p^n(p^{2n}-1)$, which is simply isomorphic with the group of all linear fractional transformations on one variable, with coefficients belonging to the Galois field $[p^n]$, and with determinants equal to unity. It is shown that when $n=1$, the group may be generated by two operations which are subject to generational relations, and these relations are determined. When n has other values, the generating operations are more numerous, but the generational relations are again determined. The validity of the theorems depends in general on the solution of a problem in the theory of numbers, which can be treated readily in any particular case. In the first paper, p is supposed to be greater than 2; the second paper deals with the case $p=2$. —Dr. H. F. Baker, (1) On the calculation of the finite equations of a continuous group; (2) On the integration of linear differential equations; (3) On some cases of matrices with linear invariant factors. In the second paper, use is made of the matrix notation for the systematic study of linear differential equations. This study leads to two independent problems. One problem consists in the determination of all irreducible types of multiplication tables of sets of matrices of the same order, a problem akin to that of the enumeration of types of discontinuous groups. The other problem consists in the investigation of the properties of a class of functions which arise by repeated integrations from simpler functions. The serial solutions which are obtained converge for all finite values of the

independent variable in a suitably chosen "star-region," and their character near the corners of the region is determined. The work is applied to elucidate the connection between the form of the system of linear equations and the form of the linear substitutions, by which the monodromy group of the system is generated. The results are exemplified by the study of particular equations of the hypergeometric type.—Prof. M. J. M. Hill, The continuation of the power series for arc sin x.—Mr. E. T. Whittaker, The functions associated with the parabolic cylinder in harmonic analysis.—Mr. H. M. Macdonald, Some applications of Fourier's theorem. The expression of an arbitrary function by means of Fourier's theorem is thrown into the form of a double integral, the path of integration with respect to one variable being part of the axis of real numbers, and the path with respect to the other variable going to ∞ in the two senses of the axis of imaginary numbers. The theorem is generalised by altering the latter path of integration, and the generalised form is applied to the evaluation of certain integrals involving Bessel functions. Numerous properties of these functions are deduced.—Rev. F. H. Jackson, Series connected with the enumeration of partitions.—Mr. W. H. Young, Sets of intervals, part ii., overlapping intervals. In the present paper, some of the methods and results of a previous paper by the same author are applied to the case of overlapping intervals on the straight line. In this way, direct proofs are obtained of a theorem in the theory of aggregates due to Heine and Borel, and of its so-called counterpart. Certain restrictions in the usual enunciation of these theorems are shown to be unnecessary.—Mr. G. H. Hardy, On the expression of the double Zeta and Gamma functions in terms of elliptic functions. The logarithms of the functions studied by Barnes (*Phil. Trans.* Roy. Soc., Ser. A, vol. cxcvi., 1901) are expressed by means of definite integrals involving the Weierstrassian elliptic and Zeta functions.—Mr. J. H. Grace, Perpetuants (second paper).

Royal Microscopical Society, November 19.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Dr. D. H. Scott, F.R.S., gave a demonstration on the microscope in fossil botany. After giving a brief history of the subject from 1833 to the present time, he proceeded to describe its principal features, aided by lantern slides projected on the screen. There were also under microscopes in the room nearly 30 slides of sections of Calamites, Calamostachys, Sphenophyllum, Lepidodendron, Bothrodendron, Lepidostrobus, Spencerites, Lepidocarpon, Lyginodendron, &c., many of these having been photographed for the series of lantern slides.—Dr. Edmund J. Spitta then described a new apparatus for obtaining monochromatic light with an ordinary mixed jet. A diagram of the apparatus was shown on the screen and also three photographs of *Amphipleura pellucida*; the first, taken with white light, gave faint indications of markings, the second, taken with a Gifford's fluid screen, showed the appearance of striæ, and the third, with blue monochromatic light, obtained by means of Dr. Spitta's new apparatus, showed the diatom clearly resolved into dots. The principal feature in the apparatus was the mounting of a Thorp diffraction film upon a corrective prism which Mr. Thorp had contrived. The diffraction film thus mounted can be used with the ordinary optical bench, giving light in a direct line from the burner to the microscope. The apparatus was exhibited in operation in an adjoining room.—Dr. P. E. Shaw sent a paper on an electrical method of taking microscope measurements.

Royal Meteorological Society, December 17.—Mr. W. H. Dines, president, in the chair.—A paper by Mr. C. V. Bellamy, on the climate of Cyprus, was read by the secretary. The mean temperature for the year at the capital city, Nicosia, is 67°·2, the extreme highest temperature being 108° and the extreme lowest 28°. The annual rainfall is about 14 inches, which falls mostly in the winter months. The author also gave particulars as to the meteorological conditions at Troodos, the sanitarium and summer resort of Cyprus, which is situated in the mountains at an altitude of more than 5000 feet above sea-level.—A paper by Mr. H. H. Clayton, of the Blue Hill Observatory, U.S., on the eclipse cyclone of 1900, was also read by the secretary. The author in a former paper discussed the meteorological observations made along the path of the total solar eclipse in the United States on May 28, 1900, and stated that he found that a cyclone followed in the wake of the eclipse—though the changes were very minute and feeble—the fall of temperature developing a cold-air cyclone in an astonishingly short time with all the peculiar circulation of wind and distribution of pressure which constitute such a cyclone. This theory was not readily accepted by meteorologists, and Prof. Bigelow, who has discussed all the observations received by the U.S. Weather Bureau, thinks that they scarcely confirm Mr. Clayton's conclusions. The author now examines Prof. Bigelow's discussion and points out that the observations really confirm his own statements.

Zoological Society, December 2.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Dr. Hans Gadow, F.R.S., gave an account (illustrated by lantern slides) of his recent expedition to southern Mexico. He described the Valley of Mexico, and discussed the question of the axolotls and their metamorphosis. He also gave an account of his ascent of the Volcano of Orizaba, and of the two types of *tierra caliente* met with on the Atlantic and Pacific slopes, and pointed out the various phases of animal life met with in these different localities.—Dr. Einar Lönnberg contributed a series of notes, illustrated by photographs, of the variations observed in the elk in Sweden, more especially as regards the form of the antlers. These the author classed in three groups—"palmate," "intermediate" and "cervine." The last were comparable to the type lately described as *Alces bedfordiae*. These differences, in the author's opinion, were not attributable either to age or to degeneration, neither did they seem to indicate racial distinction.—A communication was read from Mr. R. Lydekker, F.R.S., calling attention to a photograph of a skull and antlers of a reindeer obtained by Mr. H. J. Pearson in Novaia Zemlia. On account of the palmation of the antlers differing markedly from that of the known races of the reindeer, Mr. Lydekker was of opinion that the specimens belonged to a new race, which he accordingly named *Rangifer tarandus pearsoni*.—Mr. H. R. Hogg read a paper on the Australian spiders of the subfamily Sparassinæ. It contained descriptions of twenty-five new species and a list of those previously known.—A communication from Mr. W. F. Lanchester contained an account of the crustaceans of the groups Anomura, Cirripedia and Isopoda (marine forms) collected during the "Skeat Expedition" to the Malay Peninsula in 1899–1900.—A communication from Mr. F. F. Laidlaw contained an account of the dragon-flies of the subfamily Cænagrioninæ collected during the "Skeat Expedition" to the Malay Peninsula.—Mr. R. I. Pocock described a new species of marine spider, discovered by Mr. Cyril Crossland in Zanzibar, under the name *Desis crosslandi*.—Mr. Pocock also read a paper containing descriptions of twenty new species of harvest-spiders of the order Opiliones from the southern continents. Two of these formed the types of the new genera Sorensenella and Lomanella.

Linnean Society, December 4.—Mr. Wm. Carruthers, F.R.S., vice-president, in the chair.—Rev. John Gerard exhibited specimens of a Polygala from Grassington, in the West Riding of Yorkshire; the plant has been named *P. amarella*, Crantz. He also showed a monstrous form of *Geum rivale*, Linn., from between Long Preston and Settle; the terminal flower was apparently normal, but about one inch and a half below the calyx there appeared a whorl of about twenty petaloid members, on extremely long "claws," and surrounded by a series of leaf-like bracts.—Mr. R. Morton Middleton showed an extremely well-developed fasciated stem of asparagus.—Dr. George Henderson called attention to a passage in the Georgics of Vergil (i. 73 *seqq.*), in which the poet, after recommending a system of fallowing, proposes as an alternative means of restoring the fertility of the soil that before taking a second grain crop the soil should be refertilised by planting it with a leguminous crop. The Romans believed that these plants actually enriched the soil, especially if the roots were plentiful. It is remarkable that recent discoveries regarding the nitrification of the soil by the roots of Leguminosæ should have been foreshadowed so long ago.—The first paper was one by Dr. Gilbert C. Bourne, on some new and rare corals from Funafuti, based on material dredged off Tutanga at a depth of 200 fathoms. The only oculinid coral was *Lophohelia tenuis*, Moseley, previously only obtained at a depth of 375 fathoms; the present specimen is figured to correct the figure given in the *Challenger* report. Seven turbinolid corals were obtained, two being new to science, and figured from photographs; one, a species of Trochocyathus, having several fossil congeners.—Mr. E. A. Newell Arber gave a digest of his paper on the morphology of the flowers and fruits of the

Xylosteum section of Lonicera.—Mr. C. B. Clarke read a paper, Note on *Carex Tolmiei*, Boott. The species was founded upon a specimen from the Columbia River, to which the author had subsequently added three other plants. The author has redescribed the original specimen, and has described two of the supposed component forms as new species.—A paper by Herr C. With, of Copenhagen, was briefly characterised by Prof. G. B. Howes, F.R.S., on the Indian Phalangidæ contained in the Indian Museum, at Calcutta. The collection was put into Herr With's hands to compare with the types of Thorell's species. With regard to the distribution of forms, the author remarks that the Indian peninsula and adjacent islands seem characterised by the presence of the subfamily Gagrellinæ.

PARIS.

Academy of Sciences, December 15.—M. Bouquet de la Grye in the chair.—On the presence of argon, oxide of carbon and hydrocarbons in the gas from the fumaroles of Mont Pelée at Martinique, by M. Henri Moissan. The gas, which was collected by M. Lacroix, emerged at a temperature of about 400° C. Besides those gases which have been already mentioned as present in other volcanic eruptions, a considerable quantity of combustible gas was found, together with about 0·7 per cent. of argon. The percentage of carbon monoxide (1·6 per cent.) would render the gas very toxic, and it is possible that many of the deaths during the eruptions may have been due to this cause.—On the stability of equilibrium and the variables without inertia, by M. P. Duhem.—Experiments on the duration of the germinating power of seeds preserved in a vacuum, by M. Émile Laurent. Samples of seeds of various species of plants were kept in the dark in a vacuum, side by side with duplicate samples in air, and these were tested after intervals of two-and-a-half years, five years and seven-and-a-half years. Fatty seeds appear to keep better in a vacuum than in air, but no general rule could be deduced from the other seeds, the results being variable.—Remarks by M. le Général Bassot on the *Annuaire* of the Bureau des Longitudes for 1902.—Perturbations independent of the eccentricity, by M. Jean Mascart.—Observations of the Giacobini comet (1902 *d*) made at the Observatory of Besançon, by M. P. Chofardet. The comet appears as a small nebula of the twelfth magnitude, and has an apparent diameter of about 45″.—On the integration of a partial differential equation of the second order of the hyperbolic type, with more than two independent variables, by M. R. d'Adhémar.—A method for the electrical separation of the metallic part of a mineral from its gangue, by M. D. Negreano.—On aluminium fluoride, by M. E. Baud. The preparation of pure aluminium fluoride, $Al_2Fl_6 \cdot 7H_2O$, is described, and its thermochemical data determined.—The action of boron chloride upon gaseous ammonia, by M. Joannis.—As previous researches on the reaction between ammonia and boron chloride have given contradictory results, the reaction has been reinvestigated, especial attention being given to the temperature of the reaction, which was kept at about −70° C. Ammonium chloride and boron amide appear to be the only products; at 440° C., the latter compound is partly decomposed, the compound $Bo_2(NH)_3$ being produced.—On a violet ammonio-manganese phosphate, by M. Ph. Barbier.—The separation of the alkalis from peroxide of manganese, by M. H. Baubigny. The alkali salts carried down by precipitated peroxide of manganese, which cannot be completely removed by washing with boiling water, can be eliminated by a preliminary washing with a concentrated solution of ammonium nitrate.—The diffusion of arsenic in nature, by M. F. Garrigou. The arsenic is obtained in the state of sulphide, which is then submitted to Bunsen's flame reaction, in which a film is produced on porcelain. It is claimed that quantities of arsenic of the order of 0·00001 milligram can be detected and approximately estimated. Remarks by M. Armand Gautier on the preceding paper. In working with such minute quantities of arsenic as those mentioned by M. Garrigou, the extreme difficulty of allowing for the arsenic derived from the glass and reagents is pointed out.—On *p*-benzene-azobenzoic acid and its derivatives, by MM. P. Freundler and de Laborderie.—On oxybenzylphosphinic acid, by M. C. Marie.—On a new method of chlorination of aromatic hydrocarbons, by MM. Seyewetz and Biot. The reagent used in the chlorination is the double compound of ammonium chloride and lead tetrachloride. By its aid, chlorine derivatives of benzene, toluene, xylene, naphthalene and anthracene were readily obtained.—A cœlomic gregarian in Coleoptera, by M. L. F. Blanchard.—On the evolution of the acrosome in the spermatid of Notanecta, by MM. J. Pantel and R. de Sinéty.—Teleomitosis in *Amoeba Gleichenii*, by M. P. A. Dangeard.—On photosynthesis outside the organism, by M. Luigi Macchiati. Some facts in confirmation of the statement by M. Jean Friedel on the production of chlorophyll assimilation outside the plant. These researches prove that the principal agent in chlorophyll assimilation in the green plant, and also in the photosynthesis outside the living organism, is an enzyme and that the chlorophyll pigment appears to act as a chemical sensitiser.—The ripening of seeds and the appearance of the germinating power, by M. P. Mazé.—On the *rôle* of vortices in wind erosion, by M. Jean Brunhes.—On the ocean current near the Landes coast, by M. L. A. Fabre.—On the origin of the transversal break of the Kosva (North Ural), by M. Louis Duparc.—The rapids in the river Kosva are due to an old synclinal more or less orthogonal to the direction of the folds.—On the deposits of phosphate of lime in the Belemnites chalk, by M. N. de Mercey.—The influence of catalytic agents upon the working of the organism: spermine, cerebrine and chloradrenal, by M. Alexandre de Poehl.—The diseases of organic demineralisation: plasmatic anæmia, by M. Albert Robin.

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THURSDAY, JANUARY 1, 1903.

THE UNIVERSITY IN THE MODERN STATE.

AMONG the many documents prepared by Principal Sir Oliver Lodge in relation to the development of the University of Birmingham, there are more than one of which the interest is by no means merely local. Of these, the pamphlet entitled "Survey of the Sciences," which forms an appendix to a paper on University Development, is of especial importance at the present time, for we are glad to know that the belief that the weakness of our universities must lead to national weakness in several directions is growing with a rapidly accelerating pace.

It may be long in this slow-moving country before the influence of Brain-power on history is recognised as fully as the influence of Sea-power has been, thanks to Captain Mahan, but undoubtedly it will be bad for our future if much more time is lost.

While Sir Oliver Lodge has been investigating the "needs" of Birmingham, similar inquiries have been made elsewhere, and we have received from the Clarendon Press a statement of the "needs" of Oxford. We are glad to see that the *Times*, in a sympathetic article, goes to the root of the matter in stating that "if the pocket of the millionaire is closed, the pocket of the nation must be opened." Our eleven universities are competing with 134 State and privately endowed in the United States and twenty-two State endowed in Germany. English private endowment is much less than 10 per cent. of the American endowment, and the German State gives to one university more than the British Government allows to all the universities and university colleges in England, Ireland, Scotland and Wales put together. These are the conditions which regulate the production of brain-power in the United States, Germany and Britain respectively, so far as Universities are concerned, conditions which Sir Oliver Lodge proposes to face as manfully as he may. His paper on the "Survey of the Sciences" runs as follows:—

In a recent pamphlet I considered the question of the relation of the University of Birmingham to its central and suburban sites, with a view of determining what recommendation should be made to the Council concerning the Departments which ought to migrate and the Departments which ought to remain. I was able to arrive at some judgment on the matter except in connection with the Faculty of Science, and there the problem became so complicated that it was necessary to make a survey of the sciences in order to get the material on which to form an opinion. This survey is now printed, not only as an appendix to the former paper, but because it is hoped that it may be useful for other purposes; especially I hope that it may be of interest to those who are able to help financially in the forthcoming great educational development of the future, enabling them to realise the immensity of the area which we attempt to cover, and the largeness of the sum which could be properly invested in suitable buildings and equipment and in endowment of staff. Our position is such that if some man of power thought fit to exercise it by entrusting us with a sum of five millions for University development, it could be well and properly employed;[1] nor could such an investment fail to exercise an extraordinary influence on the progress of the country. Hitherto the ideas of this country in education and scientific research have been conceived on a wholly inadequate scale, and without proper appreciation of the vast extent of territory over which a modern University is called upon to preside.

Let us, therefore, now run over the pure sciences, and trace the collateral branches and practical applications with which they are most allied; taking them in alphabetical order, and enumerating only those sciences with which we ourselves at present in some degree attempt to deal.

ANATOMY:—is clearly so closely allied to professional medicine as practically to have drifted out of general culture; though it is to be remembered that it is in touch with Fine Art on the one side—and a course of lectures on Artistic Anatomy is annually given by our Professor or our Lecturer at the School of Art—and on another side it is in touch with the sciences of ANTHROPOLOGY and Ethnology. At the present time the course of lectures and practical instruction in the subject of Anthropology, laid down in the Calendar as an optional subject for Degrees in Science, is under the charge of the Professor of Anatomy, who has made a study of this subject and of Ethnology, particularly from the side of Prehistoric Archæology, and on two occasions has given courses of lectures on these subjects, though at the present time the plant possessed for their teaching is not large. He possesses a collection of lantern slides of an ethnological character, also a private collection of stone and metal implements, and the Summers-Freer collection is now displayed in his department; with it will shortly be exhibited—as a loan from the Geological Department to which it belongs—the Seton-Carr collection of early Egyptian stone implements; and there is, besides, a small collection of Palæolithic and Neolithic implements in the Geological Museum. A case of similar implements is in the City Museum, and there are a number of ethnological objects, some of considerable interest, in the Aston Hall Museum, which might, perhaps, become available some day for the purposes of the University.

On the practical side of colonial development modern Ethnology is a subject not altogether to be lost sight of.

ARCHÆOLOGY:—A study of the past from relics and monuments and excavated sites: skilled interpretation of which enables us to reconstruct the life of ancient times. Our present Lecturer in Greek has made a special study of Greek Archæology.

BOTANY:—Studied with us partly for its own sake as a department of Natural History, allied to Horticulture and Gardening generally, and also from the point of view of Vegetable Physiology. This science is the foundation of much of Agriculture, of Forestry, of Materia Medica, of Timber and Plant diseases, the Fermentation industries, and of many human diseases. It is allied on its morphological side with Palæontology. On its Physiological side it is largely dependent on Physics and Chemistry.

At the present time it is not now taught as a separate subject in the medical curriculum at Birmingham, but admittedly only because the course is so crowded that something had to give way.

CHEMISTRY:—This gigantic science branches out in every direction. Almost every manufacture is more or less directly concerned with it, and as a pure science it is a most important branch of Natural Philosophy in alliance with Physics.

In many places there is a Professor of its Inorganic and another of its Organic division: in Germany it is still further greatly subdivided, even from the point of view of the pure science. Flourishing departments of the new and growing science of Physical Chemistry exist at Leipzig and at other German and American Universities, in furtherance of pioneer work begun at Amsterdam and Stockholm.

As to the applications of Chemistry, they are almost too numerous to mention, and every one of them demands the full time and special knowledge of an expert. At present we have only attempted Brewing and Metallurgy.

A training in elementary chemistry, both inorganic and organic, is universally recognised as an essential ingredient in the training of a medical student.

And recently Chemistry has allied itself, on the fermentation side, with a branch of Biology, through the discoveries of the great chemist Pasteur—a subject in which our present Professor and his wife are eminent.

ECONOMIC SCIENCE:—is a branch of Sociology or the theory of Politics, of which we have recognised the commanding importance, on one of its many sides, by arranging that there shall be hereafter constituted a Faculty of Commerce. In the hands of our present Professor there is no fear lest either the term

[1] See "Concluding explanation."

Economics or the term Commerce shall be interpreted too narrowly: the two will be welded to some extent into one, and gradually it is to be hoped that the treatment of these subjects of national moment can be established on a sound and broad educational basis.

EDUCATION or Pædagogy.—The science of Education is coming to the front of practical politics in a most impressive manner just now. All that we attempt in this direction at present is the Training of a limited number of Primary Teachers, both men and women: a department which constitutes a successful and promising beginning of a most important work. But some part of the barrier between primary and secondary education is shortly to be broken down, and the Government is wisely going to insist on a training for Secondary Teachers also. It is important to remember that, for this work, teaching must be provided in all departments of ordinary knowledge, and by no means in the Arts subjects alone; though those no doubt constitute the backbone of the course. Also that methods of teaching the substance of Science (including Mathematics) and Modern Languages, in schools, are less developed and systematised than are the disciplinary methods for drilling in Ancient Languages, Euclid and Algebra. A Professorship is necessary if we are to enter into effective relations with and duly to influence secondary schools.

ENGINEERING. This science is, even more than chemistry, overweighted with its own applications; so that there is a tendency to regard it solely as an applied science. But it has a large and most important pure-science aspect, too; and on this side may be considered to consist of Applied Mechanics and Physics: meaning by that, such subjects as Thermodynamics, Elasticity, Strength of Materials, Theory of Mechanism, and much else; not to mention the enormous subject of Electrotechnics—the foundation of Electrical and Telegraphic Engineering; in fact, the ground to be covered is so large that but few Physicists are competent to treat the whole science adequately from an engineering point of view, and so a good deal falls to the province of the Professor of Engineering. At the same time a thorough knowledge of the groundwork of the pure Science of Physics and Mechanics is essential to the training of every engineer who aspires to rise to the higher ranks of his profession.

We have only to run over the aspects of Civil Engineering in its limited customary sense--Bridges and Tunnels, Reservoirs, Canals and Railways; and then to remember Marine Engineering and Military Engineering—to recognise that the whole subject is obviously gigantic. It alone could cover the whole site and employ a dozen professors.

GEOLOGY.—The great science of the earth's crust claims to deal with the constitution and history of the earth as a whole. It is in touch on the one hand with Astronomy—a science which at present we do not here attempt—with GEOGRAPHY, a science which has many aspects, both on the side of nature and on the side of the distribution of man, which are dealt with to a considerable extent by our present Professor of Geology—with MINERALOGY, which he also treats—with PALÆONTOLOGY, the Botany and Zoology of the ancient world, in parts of which he is a world-known authority--with Physics and with Chemistry, more especially perhaps with Physics, for many of the problems are the physics of the earth's crust. All this on the pure science side.

On the side of Applied Science it is in obviously close connection with Mining, with Civil Engineering, with Water Supply and with Agriculture.

HISTORY:—the science of humanity in the past, is closely allied with Sociology and Economics; it is often treated in a more literary manner than most sciences, and hence is sometimes taken for a time by a Professor of Literature; but never satisfactorily so. The whole range of ancient and modern history, of events and institutions and of constitutions, is large enough to demand the attention of several specialists, if the ground is to be adequately covered.

On its practical side it has close relation with Law and with Commerce.

MATHEMATICS:—the science of number and form, in its elementary stage, is an essential ingredient in all education, and hence is partly associated with the Faculty of Arts. In its higher stages it is essential to the Engineer, and is becoming necessary to the Chemist; and for these purposes a more immediately practical course, proceeding more quickly over the rudimentary portions, is desired. In still higher stages it is essential to the Physicist, the Astronomer, and the Natural Philosopher generally. And in its highest stages it constitutes a pure science of unexampled beauty and perfection.

The so-called Applied Mathematics, or Theoretical Mechanics, is closely allied with, and, indeed, trenches upon the mathematical side of Physics; and there is ample room for two or more professors of the different branches of Mathematics. Some day this statement will become practical politics.

MEDICINE:—is the only science which at present is adequately treated in England. A five years' course is devoted to its acquisition: and it is subdivided into a proper number of constituent parts, each dealt with by a special Lecturer.

Besides the three great sciences Anatomy, Physiology, Pathology, with which last at present the developing new science of Bacteriology is associated, there are the great practical Arts of Medicine and Surgery, together with the several branches called respectively Hygiene, Therapeutics, Materia Medica, Midwifery, Gynæcology, Forensic Medicine, Toxicology, Mental Diseases (the Pathological side of Psychology), Ophthalmology, each with a special Professor. Besides these we might have a Lecturer on Diseases of Children, another on the Ear and Throat; and we have seven Lecturers in Dentistry, a branch in which we give special degrees. There is also Pharmacy, including the training of Pharmaceutical Druggists, a branch of work we have not yet undertaken, but for which there is some demand.

Medicine therefore is a model according to which all the great sciences should be subdivided and conquered; and to some extent it is coming to be so in Germany. This country is ignorant of Science: and the administrative and commercial classes are not yet awake to its value.

PATHOLOGY.—This vitally important science used to consist wholly, and still consists largely, of post mortem operations and the study of fresh morbid specimens, with the object of throwing light upon the processes of disease; so that an essential appendage to the subject is its museum of morbid preparations; which indeed subserves also many practical branches of Medicine and Surgery.

A good *Pathological Museum* is one of the most valuable assets of a Medical School, and has been found to be a powerful factor in attracting students, as well as in maintaining the interest of medical practitioners, to whom it may be a considerable aid in difficult cases.

Nowadays the science has been illuminated and almost revolutionised by the discoveries of BACTERIOLOGY; and it bids fair to achieve for humanity the greatest service which on the terrestrial plane can be accomplished, viz., the earlier and surer recognition, the intelligent treatment, and ultimate removal, of many forms of disease.

The science is allied to Physiology, to Chemistry, to Zoology, and to Botany, and it is the root principle of Medicine and Surgery.

Its researches seem likely to open up the tropics to white habitation, thereby greatly enlarging the effective extent of the earth's surface; and, if it progresses as it has recently been doing, it is to be expected that the average duration of human life everywhere may be largely and efficiently prolonged.

PHYSIOLOGY.—This splendid science deals largely with the functions of the human body in health—indeed with organic or vital functions generally, save that those of the lower animals and of plants are generally relegated to the special sciences of Zoology and Botany. It is the Physics and Engineering and Chemistry of live machines. It is closely connected with Anatomy, which concerns itself with the discovery and enumeration of the structures themselves; and on the practical side it manifestly is closely related to Medicine. For a due understanding of the functions of the heart, the liver, the muscles, the lungs, the viscera, the nerves, the brain, the kidney, the stomach, the glands, the eye, the ear, and the other organs of the body, is essential to their proper treatment, whether by hygienic precautions or by remedial drugs; just as an exact anatomical knowledge of their position is the foundation of surgery.

The microscopic branch of Anatomy, called HISTOLOGY, the science of the minute structure of the tissues, is generally at present dealt with by the Physiologist, doubtless because these parts are intimately concerned with the business of secretion and with vital functions generally.

It has recently been customary to equip the Physiologist with a quantity of elaborate Physical instruments, chiefly for a special

study of the phenomena of nerves—in which of late years many discoveries have been made. The electrical concomitants of nervous action have been found very helpful in elucidating the processes and determining their true relations, even if they do not turn out to be themselves an essential part of the process; and accordingly the science demands extensive and expensive equipment.

From the side of the brain and nervous system it is related to the analysis of mental functions in Psychology.

PHYSICS.—Of the science of Physics I dare hardly trust myself to speak: suffice it to say that it is the chief part of Natural Philosophy, the science which covers everything except the treatment of life and mind, and it underlies every other science. It seeks to explain the phenomena of Chemistry and of Physiology, so far as can be done without trenching on the domain of Biology. It is closely allied to ASTRONOMY, it measures sizes and distances, and the chemical constituents of the heavenly bodies. It is concerned with all exact measurements, with weighings and gaugings and surveyings, all geodetic operations, and a great part of Navigation. It includes Meteorology, which is the physics of the atmosphere; it deals with Heat and Light, and Sound, including the theory of Music, with Magnetism and Electricity, with waves and vortices, with the flow of fluids, with the elasticity of solids, with the theory of gases; and it is the foundation of Engineering.

On its practical side it has blossomed in every direction: witness the pump, the barometer, the telescope, the microscope, the photographic camera, the steam engine, the telegraph, the electric motor, the electric light, the X-rays; less obviously in a multitude of other directions.

On its theoretical side it is the most advanced and extensive of the whole of the family of sciences; and a much larger staff is necessary if we are to occupy its territory in even a moderately respectable manner.

In the department of exact measurement and mathematical electrical theory our present Professor of Physics has made for himself a world-wide reputation; and the limits of discovery in a science like this are controlled more by the lack of time and of material equipment than by almost anything else.

PHILOLOGY:—the scientific treatment of language: a comprehensive subject which ranges from a competent understanding of the derivation of words to an interpretation of Hieroglyphics and of Cuneiform inscriptions, to Palæography—or the study of Ancient Manuscripts. It is thus allied on one side to History, Sociology and Folklore, on another side to Ethnology and Archæology. It welds languages into families, and traces their relationships, and on its practical side is a necessary element in the thorough study of any modern language. It is a subject in various departments of which our Professor of Classics and Lecturer in Latin are experts.

PSYCHOLOGY:—may be regarded as the highest of all the biological sciences, being the theory of mind and of mental operations in general; in another aspect it constitutes the fundamental substratum of knowledge, being the study of the processes by which we recognise the external world, and all the facts dealt with by other sciences: it is a study which on its practical side is closely allied with Education, which so far as it is scientifically based must rest upon it. In recent times experimental methods have been applied to the simpler mental operations, thus giving to the subject increasing definiteness and precision; and a large extension of knowledge is being foreshadowed in this direction by the labours of a few, as yet hardly recognised, pioneers.

Moral and Political Philosophy.—On the theoretic side Psychology lies at the base of any sound treatment of the phenomena of will and conduct, the relation of the individual to his social and political environment, the meaning and bearing upon human life of legal and State organisation. The treatment of these subjects has attracted the best minds at the highest stages of social development, both in ancient and modern times, from Plato and Aristotle to John Stuart Mill and Henry Sidgwick.

Logic and Metaphysics.—On still another side Psychology is an introduction to Logic, the science which seeks to analyse the processes followed by the reason alike in ordinary affairs and in the more familiar kinds of scientific investigation, and while offering a practical discipline in logical method and the conduct of the understanding leads in turn to METAPHYSICS or General Philosophy; which may be defined as the examination of the relation of the forms under which we know the world around us—matter, motion, life, intelligence, art, science, religion—to one another, to reality in general, and (under the name THEOLOGY) to the Divine Mind.

ZOOLOGY:—The study of animal life, from the lowest amœba to the highest mammal. On the practical side Zoologists are sent out by the Colonial Office to Ceylon to renovate the Oyster and Pearl Fishery there; by County Councils to study and improve the conditions of the sea-fishing industry round our coasts. The science has an important bearing on many of the operations of farmers, beekeepers, pigeon fanciers and veterinary surgeons; and in the United States a knowledge of many zoological facts, relating to sheep and cattle, as well as to blight, the Colorado beetle, potato-bug, and such like pests, is disseminated among farmers by a series of pamphlets issued by the United States Department of Agriculture. Zoologists are beginning to take their part also with the botanists and pathologists in the extermination of malarial and tropical disease, in which a knowledge of the life-history of the mosquito and such like insects is so important; and already it is coming to be more than suspected, especially in the light of South African enteric experience, that flies and other household insects are specifically dangerous, too.

A knowledge of Elementary Zoology, or at least of Comparative Anatomy and Physiology, is insisted on in every medical school.

The science of Zoology is sometimes sneered at as having to do with grubs, and butterflies, and snails; and so it has; but, though it has made no adequate beginning as yet, the greatest of problems lies before it—or before it and Physiology together—in the future, viz. the elaboration of a theory of the nature of life and death.

CONCLUDING EXPLANATION.

In venturing to name earlier in this pamphlet (see p. 193) such a sum as five millions, I have had in view certain considerations which it may be well to set forth.

First it has been found that the Carnegie donation to Scottish Universities is insufficient to attain its objects, and already it appears likely that it may have to be doubled.

Next it is well known, and indeed painfully familiar to all who have to do with administration, that every new department started, and every new building erected, means an increase of current expenditure and a drain upon resources. Expenditure is called for on behalf of rates, portering and cleaning, heating and lighting, maintenance, depreciation and supersession of equipment, and materials for experiments and processes. There are also annual grants to be made to the Library, to the various Laboratories and Museums, and to departmental Libraries. Then there is a large disbursement for salaries of demonstrators and curators and assistants and technical instructors. All these expenses come out of revenue, and are probably best provided for by the income derived from fees, and from the contemporary support of County and other bodies so as to preserve dependence on the interest of the living generation. But it is highly desirable to keep fees low—not by any means to abolish them, but to keep them low—so as to bring higher education within reach of all who are able to make use of it: a number which, with the improvement of schools, will probably be rapidly increasing. Hence it is probable that the above-mentioned items of annual expenditure will absorb the whole of the ordinary annual income and leave nothing for the payment of the chief Professors and Lecturers. Everywhere it has been found essential that chairs shall be endowed, so as to put them on a permanent and substantial basis; moreover, it is vitally important to be able to attract the best men, wherever they are to be found. At the present time it is not usually possible to compete with other places for the best men unless we can offer a sum comparable to 1000*l.* a year, and in some subjects more.

An invested million will therefore on the average relieve the annual income of the stipends for 30 principal chairs. There must be a large number of Lectureships, or subsidiary and supplemental chairs, and 60 of these at 500*l.* each could be provided with the second million.

The buildings already in progress on the new site are to cost more than a quarter of a million, and the remainder of what has been sketched out and actually contemplated will cost the other three-quarters. Another half million at least will be needed to equip them properly.

The older or central site will also need considerable enlargement, and fresh buildings should rise there. Half a million may be set aside for ultimate building and equipment on and near the Mason College site.

Four out of the five millions are thus accounted for; the fifth is intended for a real attempt at scientific research in all departments. A fund by which men could be sent to any part of the world: to study tropical diseases, or fisheries, or mining possibilities—to investigate either nascent industries or injured industries of any kind: a fund which could equip research laboratories at home, and could defray the expense of researches undertaken on a large or engineering scale, so as to bring in rapidly some practical results. At present there are men who perceive how many things could be reformed or improved, whether in purification of the atmosphere, or in novel modes of locomotion, or in many other ways; but they lack the means to demonstrate their plans or to try experiments. Manufacturers and Municipalities sometimes try experiment on a very extensive scale indeed—a really commercial scale—and in case of failure the resulting experience is over-dear. The endowment would not allow experiments on such a scale as that; considering the variety of subject, the amount available for each would permit of no extravagance. Some of the experiments undertaken would undoubtedly fail, yet the success of a few would far more than compensate for the failure of many, and the activity could not but conduce to progress.

The fund would have to provide, not only the necessary appliances and assistance, but it would endow fellowships for post graduate study, and would attract workers from many parts of the world, and certainly from the Colonies.

One Principal could not possibly supervise all the multifarious activities which we have thus supposed may some day be called into being. There would have to be a Research Principal (whatever he might be called), to organise and superintend the scientific and post graduate study; a Technical Director, in touch with all the technical departments; and an Educational or General Head, to supervise the general scheme of the College in all its various avenues to a degree, and to take a lead in whatever conduced to general culture.

If the scheme is lavish it represents lavishness in the right place. It is the kind of lavishness for which the nation is waiting—one of the few kinds of which hitherto it has been afraid.

> "There is that scattereth but yet increaseth:
> There is that withholdeth more than is meet, but
> it tendeth to poverty."

These lines refer not to individual wealth alone, but to National wealth also. We have failed to make the most hitherto of the brains and energy of our more able and specially-gifted youth, but have cramped them by the necessity of earning a living: a process wholesome enough for the individual, and right for 999 out of every thousand, but for the remaining one far less repaying to the Commonwealth than the special service which he could render, if set free and encouraged by suitable surroundings for a few years of research, following on a thorough educational preparation. Not all of these would justify their selection: nine-tenths of them even might do only moderately well; but the discoveries of the select tenth would be of incalculable value. The world has been wasteful of its genius hitherto. It thinks too facilely that people exceptionally endowed will struggle to the front somehow. A few do, but a number do not; the conditions are not favourable; and the struggle for existence, though doubtless a stimulating training for the hardier and sturdy virtues, is not the right atmosphere for the delicate plant called genius. Different kinds of treatment are suited to different characters, and the hot-house plant will not thrive in bracing arctic air.

From the Trust Deed with which Mr. Carnegie has endowed a research Institution at Washington with ten million dollars, I extract the following altogether admirable statement of "*aims*":—

"1.—To promote original research; paying great attention thereto, as one of the most important of all departments.

"2.—To discover the exceptional man in every department of study, whenever and wherever found, inside or outside of schools; and to enable him to make the work for which he seems specially designed his life work.

"6.—To ensure the prompt publication and distribution of the results of scientific investigation; a field considered highly important.

. . . "The chief purpose of the founder being to secure if possible for the United States of America leadership in the domain of discovery, and the utilisation of new forces for the benefit of man."

MUTUAL AID.

Mutual Aid, a Factor of Evolution. By P. Kropotkin. Pp. xix + 348. (London: Heinemann, 1902.)

THIS book is undeniably readable throughout. The author has a creed which he preaches with all the fervour of genuine conviction. He is anxious to make converts, but his zeal never leads him to forget fairness and courtesy. Those who disagree with him may learn much by studying the book.

The line of argument is, briefly, as follows. In the case of animals, there is very little evidence of any struggle for existence among members of the same species, though plants, beyond all doubt, jostle their own kin out of existence. Animals are, as a rule, banded together for mutual protection, and those that have the best organisation for mutual defence are those that thrive best. Such species are represented by large, often by countless, flocks. Those that are least sociable, such as the great carnivores, are far less vigorous, to judge by their small numbers, and barely hold their own. The term "struggle for existence" should not, therefore, be used in a literal sense, as if there were an unceasing internecine war between the members of the same species, a limited amount of food available and no individual able to dispel the cravings of hunger except by robbing his own kin and reducing them to starvation. So far from this, we see mutual aid almost everywhere. There is a struggle for existence, but only in a wide, a metaphorical, sense. There is at normal times plenty of food, and there is, therefore, no need for fighting among the members of a species. Rats are a painful exception, and the cries of distress that come from cellars tell of their fights and their cruelty.

Turning to men, we find that mutual aid is, or at any rate has been in the past, even more general than among animals. Among savages, mutual aid is the chief factor in evolution. The individual is never isolated, but is one of a clan. Among barbarians, we find the same tendency to sociability and cooperation, but historians, by dwelling exclusively on wars, have misrepresented the facts. When the clan broke up, men formed village communities. So unwilling were they to fight that they got soldiers to protect them, and in many cases became the slaves of their protectors. The risk of this led to the growth of the mediæval town; it was a union of several village communities for defence against marauders. Within the larger community of the town were smaller associations, the guilds. In these mediæval towns, the arts flourished to an extraordinary degree. Sometimes leagues of free cities were formed, and held their own against all enemies. But in time these little homes of freedom disappeared. The big centralised State arose and crushed out those smaller communities that existed for mutual help. Within the State has sprung up an individualistic civilisation, but even now there is an enormous amount of mutual help. There are benefit societies, cooperative associations, trades' unions.

Moreover, the poor have the habit of constantly helping one another in all their troubles.

In every line of the book you see the eagerness of the writer to make the lives of men happier. So zealous is he that he attributes to the lower animals a benevolence similar to his own. But has he correctly represented the struggle for existence? It is true that he partly succeeds in making good his first contention, that there is not much evidence of a fratricidal struggle between members of the same species. Still, there is a great deal more than he would have us imagine. Rats, he owns, are sad offenders. Can we be sure that the same spirit does not show itself among other animals when a crisis comes? And crises, though Prince Kropotkin does not allow it, are all-important from the point of view of natural selection. Do not cattle in time of drought trample each other to death in their efforts to get what water remains in a pool here and there? Do they not, even in normal times, prod with their horns and bully a weakly member of the herd? Mr. W. H. Hudson, a most unwilling witness, testifies to this. Even maternal affection is strictly subordinated to the needs of the species. I have recently heard of a well-authenticated instance of a kid which was being gored to death by its mother because it was weakly, and it was only saved by being removed from her. Pigeons are very affectionate towards their young, but as soon as the young are able to fend for themselves, the affection comes suddenly to an end, and is often succeeded by a strong tendency to tease and worry.

Prince Kropotkin tells of crabs that worked hard and long to put one of their kind, that had got overturned, right side uppermost. This is indeed a remarkable phenomenon, hard to parallel even among animals a great deal higher than crabs. Swans will drive their young away from their pond. Eagles will not tolerate rivals within a certain radius of their nest. Besides this, there is sexual selection, which often takes the form of selection by battle. I have read Prince Kropotkin's book from cover to cover, and find no mention of the habit, so common among males, of fighting for supremacy. In the index there is no reference to it. Yet sexual selection is an important form of natural selection: its total omission is extraordinary.

Prince Kropotkin certainly succeeds in showing that mutual aid is very frequent among members of the same species. Probably Darwin underrated the amount. But it is because they have formidable enemies that they assist one another. In fact, the struggle for existence is all the keener because they are formed into troops or armies. Mutual aid cannot "eliminate competition" (p. 74). True, it dignifies and ennobles it, but it makes it more intense. Whatever vigour any species possesses results from competition. If civilised men are stronger than barbarians, it is not because they suffer less from competition. The civilised races have gained their strength in the stress of the struggle for existence, and they retain much of it because there is still a struggle against cold, want and disease. The struggle against physical conditions is the only one that Prince Kropotkin recognises as normal and natural. As for lions and tigers, he deprecates their existence; in his eyes, they have no *raison d'être*. Yet they may claim the credit of having developed the habit of mutual aid among the ruminants. What need for mutual defence if there are no enemies? Birds of prey in the same way have fostered cooperation among the members of the species on which they make their raids.

As to the comparatively small numbers of the carnivorous animals, we need not attribute this, as our author does, to their want of cooperation. It is a question of food supply. Plants are more abundant than animals because they live on inorganic food, and that is plentiful. All animals require protoplasm that has been prepared for them by vegetables. This introduces a limitation of the food supply. The flesh-eaters must have it still further prepared by the vegetable feeders. Were there yet another class of animals that could subsist only on the flesh of carnivores, they would be still fewer in number than the class on which they preyed. Prince Kropotkin seems unaware of the influence of one species upon another. The keen eye of the falcon and his splendid swoop have necessitated counter developments in the species among which he seeks for his victims. Mere physical conditions, seldom changing, would never have brought about the evolution of the noblest forms of life. This could only be achieved through the interaction of competing species. The advance of one—the gain of keener sight, of greater speed or greater courage—has necessitated a corresponding advance in others.

Prince Kropotkin's failure to grasp this prevents him from understanding the growth of civilisation. His creed does not allow him to understand that the clan, the village community, the mediæval city, all derived their vitality from the fact that they had enemies to contend against. War necessitates loyalty and cooperation, as our author, at least in one passage, owns, and yet he will not allow that it has played any good part in evolution. The passive friendliness of all law-abiding citizens towards one another and the efficiency of the police prevent cooperation from being what it once was. It is only the largest cooperative association, the State, that can evoke enthusiastic loyalty and devotion, and this is, obviously, because nations have not yet done with war. If the law did not prevent active hostilities between trading associations, we should soon see institutions similar to the mediæval cities arising. Moreover, our philanthropic principles hinder us from bringing that pressure to bear upon the idle and corrupt which was essential to the successful working of the old guilds. Prince Kropotkin tells us that "the craft organisation required, of course, a close supervision of the craftsmen by the guild." An idle member might be ejected, and his fate would, probably, be far worse than that of the modern idler who tramps from workhouse to workhouse. It is not in benevolence we fail so much as in the sternness that is wanted for the proper treatment of the dregs of society. There are many persons whom society can only help by compelling them to help themselves. And such drastic measures Prince Kropotkin does not seem to recommend. He would abolish individualism. But how would he make the loafers, who will not work for themselves, bestir themselves on behalf of an association?

F. W. H.

THE FORESTS OF UPPER INDIA.

The Forests of Upper India and their Inhabitants. By Thomas W. Webber. Pp. xvi + 344; with 2 maps. (London: Edward Arnold, 1902.) Price 12*s.* 6*d.* net.

THE title of this interesting book is somewhat misleading. In the first place, the author deals with only a fraction of the forests of Upper India, namely those of the districts of Kumaon (with a visit to Thibet), Gorakhpur (with a dash into Nepal), Jansi, Bundelkund, and the northern part of the Central Provinces. In the second place, he gives far more information regarding the inhabitants, whether men or animals, than of the forests themselves. Indeed, the information regarding the latter is very sketchy and not up-to-date. What the author does say in this respect refers to a state of things existing some thirty-five to forty years ago, and we have now far more complete accounts than those contained in this volume. Nor is the information in this respect always very accurate. On p. 38, for instance, he gives the area of the Kumaon hill forests as 15,000 square miles, while the whole district in which they are situated is given as 150 miles long and 100 broad, which also comes to 15,000 square miles. At p. 184, on the other hand, the area of forests surveyed in Kumaon is said to amount to 1074 square miles. Again, at p. 41, it is stated that the silver fir grows on the northern slopes at an elevation of 12,000 feet, whereas that is practically the upper limit, the tree being usually found between 8000 and 12,000 feet. On p. 194, the author says that Sal is found in the Mysore hills and Tenasserim. This may have been believed fifty years ago, but it has long since been found that the southern tree is not Sal, but another Dipterocarp. Of Deodar, the most important tree of the Himalayas, we hear very little.

The information given of the forests serves, as a matter of fact, only as a frame, into which the author places the description of his travels, *shikar*, or sport, and enumeration of animals which he has met. This account will, we feel sure, interest many readers. The author despises ordinary shooting as now practised in these islands, but he loved stalking interesting animals, especially big game, in many of the out-of-the-way places which he visited between the years 1861 and 1871. He also gives an animated account of various wild or uncivilised tribes and their manners and customs. One of the most interesting parts of the book is, no doubt, that in which he tells us that, just inside Thibet, he came across the descendants of the famous Huns, which overran the greater part of Europe some 1500 years ago. Whether his surmise is correct or not, we shall not risk to say, but from the description which he gives of the present-day Huns, it is clear that these must have greatly degenerated since the sojourn of their ancestors in Europe.

The author's account of the animal life in the districts which he visited is very full and is told in an attractive manner. At the same time, we think that literary license and colouring have been employed in a somewhat excessive manner. It is quite wonderful to read of all the different kinds and numbers of quadrupeds and birds which our author has seen and, in many instances, shot. We cannot do better than give an extract from the chapter headed "The Bori Forest" (pp. 299-303):—

"The glory of the village was an immense banian-tree, standing alone and covering half an acre of level ground. . . . This great fig tree is in itself a whole aviary, affording both shade and figs, and insects and grubs, and safety from numerous enemies of the hawk tribe. There is the golden oriole (*Oriolus kundoo*), which makes a melodious whistle very like the ring of glass, short, single, and descending two octaves . . . Many little squirrels . . . came skipping and cocking high bottle-brush ringtails. . . . Among the thick, shiny leaves there is a sparkle of canary-yellow and bright scarlet; this is the female and male minivet or cardinal bird. There are many kinds of woodpeckers, which tap on the stems and screech. A dark-greenish bird sits in the shade—the koel. He makes the grove resound with his frantic cry, 'I've lost my shirt.' . . . The air is full of swifts and swallows, darting ever after insects. . . . At no time or place is there an interval in the wheeling of long-winged kites high overhead. . . . Towards evening . . . a little owl says 'Piu!' from the recesses of the many air-roots which hang overhead. Then . . . a hundred green paraquets screech all together. . . . There are flocks of the common large green paraquet, the smaller rose-collared *tota*, and many kinds of plum-headed paraquets, and slaty-headed and red-breasted parrots of all sizes. . . . There are notes of various owls . . . the purring also of the goatsucker. . . . Stag-beetles drone as they swing by, and cockchafers and the cicadas in the trees keep up a creaking which seems always in the air, and there is never silence."

Who would not like to see such a banian-tree and to sit under it and watch the variety of life here depicted by the author?

Men with a more practical turn of mind would perhaps fasten on another very short passage in this chapter (pp. 309-310), where it is said:—

"The complete exclusion of jungle fires, which had been successfully carried out for some years previously, certainly showed its effect, as fine saplings, grown from seed, of teak and other sorts were plentiful through the forest."

The author dismisses the subject with these few words, and yet this operation was of immense importance, as the protection from fire of the Bori Forest in the Central Provinces was the first thoroughly successful experiment of the kind, continued over some forty years. It was the beginning of a system of successful fire protection now carried on in all Indian provinces, a system which gives protection to some 30,000 square miles of the more valuable Indian forests. One of the greatest achievements of the Indian Forest Department is the success with which such extensive areas of valuable forests are now protected from the devastation formerly wrought in them by the annual forest fires. Whoever may have started the idea, so much is certain, that the officer who was the first to be thoroughly successful in this great work is Colonel Pearson, at that time Conservator of Forests in the Central Provinces.

In the appendix, the author gives us his ideas of "the scientific management of forests," and he winds up by reading a lecture to the Government on the neglect which forestry has met with in these islands. The author draws attention to the serious consequences which are likely to arise if something substantial is not done at once in augmenting the wooded area of Great Britain and

Ireland, as well as in introducing some rational system of management into the forests of the colonies. Let us hope that his words will fall on fruitful ground.

In conclusion, we cannot omit expressing our admiration for the cheerful way in which the author went through most fatiguing journeys and the healthy tone of his remarks on the love of nature. We feel sure that the attractive way in which the book is written will secure for it many readers.

THE ASCENT OF MIND.

Mind in Evolution. By L. T. Hobhouse. Pp. xiv + 415. (London: Macmillan and Co., Ltd., 1901.) Price 10*s.* net.

IN this able and thoughtful work, Mr. L. T. Hobhouse distinguishes five stages of correlation in the ascent of mind, from the first glimmerings of consciousness in some lowly organism of primeval times to the systematic thought of the man of science or the philosopher and the intuitive insight of the poet or artist. The first of these, placed in a category by itself, is the pre-intelligent stage, wherein there is an indirect correlation of experience, reaction and welfare before intelligence (which is defined as the capacity of the individual to learn from experience) comes into play. The behaviour of the organism is, at this stage, the outcome of inherited structure, and if any variation of structure secures a more suitable response, that is, one better adapted to preserve the organism or its offspring, such a structure would tend to be "selected," since the individual in which it occurred would have an advantage in the struggle for existence. In this way, inborn tendencies to a given method of response may be correlated with the past experiences of the race.

It will be noticed that the word "experience" is here used in a non-psychological sense. Instinctive reactions are the culminating products of this stage of pre-intelligent development. Above and beyond this comes the comprehensive category, the second of the two which Mr. Hobhouse distinguishes, wherein the correlation is based on individual (psychological) experience. This category comprises four stages; first, that of the unconscious readjustment, where the pleasure or pain consequent upon instinctive or random response to stimuli modifies subsequent reactions in a manner determined by the nature of the feeling; secondly, that of concrete experience and the practical judgment. Here behaviour becomes purposive, and the appearance at this stage of actions definitely directed to, and determined by, the ends which they serve, is regarded by Mr. Hobhouse as perhaps the most critical moment in the evolution of mind. In purposive action, so far as it is purposive, there is no fixed habit, but the response to the surroundings is determined by the effect which it will have in the particular case; that is to say, by the relation between act and consequence. Hence the organism at this stage does not respond uniformly to similar surroundings, but takes into account anything that, though outside the range of immediate perception, is relevant to the object to be attained. Within this stage are reached the limits of animal intelligence.

The connection between the perceived relation and the action based on it remains, however, unanalysed. The steps by which this bond of connection is analysed out as a distinct content of thought lead us to the third stage, that of conceptual thinking and will, and of the correlation it involves, language, both as cause and effect, is the central feature. In scope, the correlation that is now made possible is immeasurably widened. In the conceptions of this stage, thought first finds itself possessed of contents set free from the line of practical interests and also from strict conformity to the perceptual order. In this way a "world of ideas" is formed, going beyond as well as behind experience, and the conceptions which people this world form ideal schemes to which grouped experiences may be referred. Conduct is adjusted to meet the requirements of self or others as persons, of society as an abiding structure, or of morality as a system of universal rules. In fine, the correlation is now between the focussed results of connected bodies of experience and broad purposes of life or general standards of conduct.

The fourth and last stage—that of rational system—arises when the formation of a coherent, self-supporting, exact and exhaustive body of knowledge begins to be an explicit object of mental effort. The stage would be complete when such a system should embrace the conditions and possibilities of evolution, and should reach a complete synthesis of reality as a whole.

Such, stated for the most part in his own words, is a summary of the successive steps which Mr. Hobhouse traces in the ascent of mind. His work is characterised by breadth of view, logical development and fertility of illustration. It is an earnest attempt to grapple honestly and fairly with difficult problems in a spirit of serious investigation. Personally, I am of opinion that Mr. Hobhouse's psychological stages one and two—those of unconscious readjustment and of concrete experience—are much more closely related than is concrete experience to conceptual thinking, which again shades off into that of rational system. Dr. Stout's broader division into perceptual and ideational phases of mental development seems preferable. Within these might fall Mr. Hobhouse's subdivisions. The generic differences between the broader categories are not difficult to trace; but the specific differentiation of the subgroups is a less easy matter and one which leaves room for more difference of opinion.

A noteworthy feature of Mr. Hobhouse's work is the careful record of observations conducted under experimental conditions on cats, dogs, a rhesus, a chimpanzee, a seal and an elephant. His method seems preferable to that of Dr. Thorndike, since the conditions are less cramping to the intelligence; and though his interpretation is in some cases open to criticism, his honesty of purpose is unquestionable. If, making due allowance for differences in the usage of technical terms, for diversities of outlook, in a word, for the personal equation, we compare his results—for example in the study of monkeys—with those of Dr. Thorndike and of Mr. Kinnaman, we cannot but be struck by the large measure of agreement that may be found in views which, to some readers of their works (and perhaps still more to the writers themselves), may seem divergent. C. LLOYD MORGAN.

SCOTTISH GEOLOGY.

The Geology of Eastern Fife. By Sir Archibald Geikie, D.C.L., F.R.S. Memoirs of the Geological Survey, Scotland. Pp. xv + 421; with map, 12 plates and 71 figures in the text. (Glasgow, 1902.) Price 8*s*.

IT is not given to every author of a Geological Survey memoir to write an interesting as well as instructive volume. Too little attention has been paid to style and composition, while the necessity for recording many and often dry facts has had a tendency to obscure the philosophy of the subject in many of the official publications.

When, however, as in the present instance, the information is conveyed in a pleasant style and in well-chosen language, we feel that the science is placed on a higher level and that the task has been performed in no perfunctory spirit, but with the desire to make art a companion of science.

Sir Archibald Geikie has occupied much of his leisure time since he retired from the Geological Survey in writing a memoir on the geology of eastern Fife, which may be regarded as a sequel to his "Geology of Central and Western Fife and Kinross," published two years ago. He conducts us now eastwards into a region perhaps fuller of geologic interest. Composed mainly of Old Red Sandstone and Carboniferous rocks, it is diversified by the occurrence of contemporaneous eruptive rocks in both systems and by the further evidence of later igneous action, probably for the most part of Permian age, in numerous volcanic vents—necks or chimneys—filled with tuff or agglomerate, and in sills and dykes of dolerite and basalt. As the author points out, there is hardly any other region in Britain where lessons in practical geology could be better taught. On the coast, the rocks have been dissected and washed clean and bare by the tides, and they afford illustrations of stratification, jointing, curvature, intrusion and other characteristic structures of the earth's crust. Fossils in great variety are found in many of the strata. The Old Red Sandstone of Dura Den is a classic locality, one of the chief repositories of the fishes such as Bothriolepis, Phyllolepis and Holoptychius. In the Carboniferous rocks, there are banks of corals and crinoids in the marine limestones, shales with ostracods and bone-beds with fish-remains in the estuarine strata, and plant remains with erect and prostrate tree-trunks in the more distinctly terrestrial deposits. A general list of all the fossils has been drawn up by Mr. B. N. Peach, who acknowledges the help received from several specialists.

Workable coal has locally been found in the Calciferous Sandstone Series, but the chief development of this mineral is in the Carboniferous Limestone Series and in the Coal-measures. Full particulars of these strata are given.

The author's attention is naturally attracted to the eruptive rocks, and more especially to those which have invaded the Carboniferous strata. The sills form a remarkable group ranging from a few inches to masses more than 100 feet thick that form prominent ranges of hills. They are nearly all dolerites. The distinctive feature in the geology of eastern Fife is, however, the series of volcanic necks, of which about eighty have been observed; and, as the author remarks,

"they furnish an unrivalled body of material for the study of phenomena in the structure of volcanoes which are inaccessible at the active vents of to-day."

They

"mark the sites of former volcanic orifices by which egress was obtained to the surface for highly heated vapours, gases and other materials from the interior of the earth."

Notes on the petrography of the igneous rocks are contributed by Dr. J. S. Flett and Mr. H. J. Seymour.

Many other topics of interest are dealt with by the author, such as the glaciation, as evidenced by the ice-worn rock surfaces, the Boulder-clay and the Kames. The raised beaches and submerged forests likewise claim attention, and there is an instructive chapter on the latest geological changes in which the famous Links of St. Andrews and other places are duly described.

The work is illustrated by a clearly printed geological index map and numerous excellent pictorial views and sections.

ELEMENTARY MENSURATION.

Elementary Plane and Solid Mensuration, for use in Schools, Colleges and Technical Classes. By R. W. Edwards, M.A. Pp. xxx + 304. (London: Edward Arnold, 1902.) Price 3*s*. 6*d*.

THIS book begins with an explanation of the nature and use of logarithms, followed by that portion of trigonometry which deals with a single angle and the application thereto of logarithmic calculation. Then comes a short chapter on calculations relating to parallelograms, and this is followed by one on triangles, wherein there is such further development of trigonometry as is required for the solution of triangles from the usual data. After this, rectilinear figures are treated of in the order of simplicity—trapeziums, regular polygons, &c. We have then a very useful little chapter on similar figures of various kinds, illustrated by a considerable number of numerical examples, followed by one on irregular rectilinear figures in general. Next follow calculations relating to the circle, illustrated by nearly ninety examples. Modern demands for the employment of squared paper and graphic representation are satisfied by a short chapter on graphs, and this leads to an exposition and application of Simpson's rule. After this comes the treatment of solids in the order of simplicity, and all the well-known rules are proved and illustrated by numerous examples. No rule is given without the proof, the author saying in his preface that

"students of elementary mensuration are frequently obliged to be content with a mere statement of the rules employed and with working out examples on these rules."

This was, no doubt, true of treatises written thirty or forty years ago, but it has ceased to be a true criticism of recent works. The mensuration of solids concludes with a long chapter on the sphere which will be a help to the student in his study of spherical trigonometry.

It will thus be seen that this book contains all that is necessary for the ordinary work of the surveyor and the engineer, and that, as regards the amount of knowledge

of logarithms, algebra and trigonometry required as a preliminary, the work is self-contained.

The author says in the preface that he would "like to have added chapters on surfaces of revolution, centroids and radii of gyration"—subjects which are usually confined to treatises on the integral calculus. It is high time, however, to take them out of the exclusive control of the severe exponents of pure mathematics and to bring them more into contact with practical needs by means of arithmetic. More especially is this true with regard to what are called "moments of inertia"—a term so wide of the thing intended to be signified that it is a perpetual stumbling-block to perception in the mind of the average student. What can be the meaning of the "moment of inertia" of a mere *area* about an axis? Is not the notion of a *mean square of distance*, whether of a material body or of a mere area, from an axis something the nature of which is more readily grasped and firmly retained than the ordinary term *square of the radius of gyration?* The *square root of the mean square of distance* is what is universally called the "radius of gyration." No doubt, the expression sounds strange at first to the student, but the strangeness rapidly wears off; and the notion of a *mean square*, whether of distances or of velocities, is one which so often occurs in various branches of physics that benefit to the student would result if a "radius of gyration" were presented to him in this way. The notion is one which preeminently lends itself to arithmetical illustration and treatment; it is found, for example, to work admirably with certain engineering students, and we commend it to the consideration of Mr. Edwards when he prepares the second edition of his useful work.

OUR BOOK SHELF.

Traité encyclopédique de Photographie. Third supplement. By Charles Fabre. Pp. 423. (Paris: Gauthier-Villars, 1902.) Price 10 francs.

THIS supplement constitutes the seventh volume of Prof. Fabre's work, and covers the period from the date of the second supplement, 1897, to May of the present year. On turning over its pages, one cannot but be struck by the very large amount of space devoted to apparatus. More than 230 pages are so utilised, while negative making has but 54, direct printing methods 41, and photo-mechanical methods 11. It is needless to add that while lenses, cameras, shutters, &c., are dealt with in full detail, the progress of photography itself is inadequately treated. Some important matters, concerning which one would naturally turn to such a work as this, are omitted, and others are only referred to. This tendency to neglect photography for the sake of photographic apparatus is more or less general in the larger treatises on the subject; perhaps, therefore, this kind of manual best meets the general demand. But it is difficult to understand why the photographic student should desire a full technical description of every variety of objective and be satisfied with little more than a popular summary of work done in the science itself. We know of no treatise that gives any approach to a complete survey of the science of photography. And seeing that the present position of the science is so largely due to work done during the last ten, or at most about twenty, years, the need for a comprehensive treatise written from our present standpoint is obvious.

The character of Prof. Fabre's work is too well known and appreciated to call for detailed reference in connection with a supplement. The author might perhaps have been a little more up to date in some respects. He might, for example, have stated that the Royal Photographic Society has at last withdrawn its unit of $f/4$ for lens apertures and recognised that the natural unit is $f/1$. On the other hand, he could not have recorded the similar step taken by the International Congress of Paris, as their acceptance of the natural unit was not announced until after the first part of the supplement was published. The table at p. 43, showing the various series of empirical numbers that have been used for indicating apertures, is therefore now almost wholly a matter of history.

Astronomy Without a Telescope. By E. Walter Maunder, F.R.A.S. Pp. xii + 272. (London: *Knowledge* Office, 1902.) Price 5*s*. net.

BY collecting these papers on "Constellation Studies," "The Zodiacal Light," and other subjects for the amateur astronomer, Mr. Maunder has directed attention to many interesting observations which can be made without instrumental aid.

The book is divided into three sections, (1) constellation studies, (2) astronomical exercises without a telescope, and (3) astronomical observations without a telescope; and it is illustrated by 44 charts and photographs, and 12 excellent star maps. The object of the book is to encourage naked-eye observations, and this is kept in mind throughout, though for some parts of the subject an ordinary field-glass is allowed.

In "Constellation Studies," the reader is introduced to the constellations and their units, an intimate knowledge of which the author counts a *sine qua non* in the prosecution of the exercises and observations mentioned in sections ii. and iii. This instruction is given in a readable and interesting form, and seems to deal with all the objects which are of interest to a naked-eye astronomer. With the aid of frequent quotations from Aratus and some of the ancient rhymesters, the historical and mythological allusions to constellation and star names are explained in an instructive manner.

In sections ii. and iii., the observer is given assistance for the *scientific* observation of some ten different astronomical phenomena. For instance, in the chapter on "Meteors," a list of questions is given which observations of the meteor should answer, and, further, the unnecessary, but usual, complicated remarks are indicated. In the chapter on "Auroræ," also, there are hints on what to look for and what to note; whilst such suggestions as an apparent connection between the apex of the "Zodiacal Light" and the Pleiades will encourage amateur astronomers to make patient and persistent observation. The chapter on "New Stars" indicates another field of possible usefulness.

With the exception of the introduction of "Columbia" for "Columba" on map 12, the book seems to be free from typographical errors, but we would express a regret that the names of the letters of the Greek alphabet, when used to designate a star, were not printed in a different type from that used for the *proper* names of the stars, because, despite the explanation of the alphabet given as an appendix, this is likely, at first, to form a stumbling-block to readers who are not familiar with the names of the Greek characters.

Aids to the Analysis and Assay of Ores, Metals, Fuels, &c. By J. J. Morgan, F.I.C., F.C.S. Pp. viii + 105. Students' Aids Series. (London: Baillière, Tindall and Cox, 1902.) Price 2*s*. 6*d*.

THIS little book is intended for the use of students and others to whom the more expensive standard works on analysis and assaying are inaccessible. It is entirely devoted to quantitative estimations, and some two hundred methods are concisely described. It contain

the assay of the ores of gold, silver, copper, lead, tin, zinc, iron, manganese and chromium, and the estimation of the impurities usually met with in these metals. There are also sections devoted to the analysis of fluxes, refractory materials, slags, fuels, &c., and of white alloys, iron alloys and copper alloys. This enumeration is enough to show that an enormous amount of ground is covered, and in such a small book there is, of course, no room to explain the principles on which the directions are based. The directions themselves, however, are clear and generally accurate. Among the mistakes and omissions which have been noticed, the neglect to reoxidise the lead reduced by the filter-paper in the ignition of lead sulphate and an erroneous method of calculating the gold contained in ores may be mentioned. The modern method of adding zinc acetate instead of soda and acetic acid in the iodide copper assay is not mentioned, and electrolytic methods generally are ignored. The book should be useful to students in polytechnics and other evening schools.

First Stage Mathematics. Edited by W. Briggs. Pp. vii + 186. (London: Clive, 1902.)

THIS volume of "The Organised Science Series" deals with the geometry and algebra required for Stage i. Mathematics in the South Kensington examinations. In section i., the text of Euclid i. is strictly followed, with occasional notes and explanations. Useful summaries of the propositions are given, also several sets of easy exercises and a number of miscellaneous riders. A few additional propositions are proved, and hints are given on writing out proofs.

In section ii. (algebra), in one or two places the reasoning does not appear quite satisfactory. For example, on the sign of a product, on p. 21:—"Suppose $+2\times-3$ or $-2\times+3$. Evidently the product will not be the same in either of these cases as in $+2\times+3$. Therefore we assume that $+2\times-3=-6$ and $-2\times+3=-6$. *Therefore, when one term has a plus sign and the other term has a minus sign the product is minus.* Again, suppose -2×-3. This is different from the last two cases, and we assume that $-2\times-3=+6$. Therefore, when two terms with minus signs are multiplied together the product is plus. From these results we can infer the rule of signs." A statement of this kind almost inevitably tends to fog the mind of a student.

The use of the word *sum* (as on p. 52) in any other than its exact algebraic meaning, in a text-book for beginners, is objectionable.

There are numerous easy exercises in algebra, also arithmetical questions from previous papers.

The book is well printed, and the figures in the geometry are clearly drawn.

Preparatory Lessons in Chemistry. By Henry W. Hill. Pp. v + 122. (London: Allman and Son, Ltd.) Price 1*s.*

THE order of treatment in this little book represents the method of teaching chemistry more common twenty years ago than now. Before being set to examine for himself easy familiar chemical changes in a scientific manner, the beginner is expected by the author to be able to understand such subjects as atoms and molecules, formulæ and equations, and similar matters much more suitable for students at a later stage of work. Several better books for beginners in chemistry are available.

My Dog Frizzie and Others. By Lady Alicia Blackwood. Pp. 44. (London: Operative Jewish Converts' Institution). Price 4*d.*

THESE are simple, interesting stories concerning the habits and character of a pet dog. The tales may encourage children to study animals intelligently.

LETTERS TO THE EDITOR.

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Sound Waves and Electromagnetics. The Pan-potential.

THE photographs taken some years ago by Prof. Boys of flying bullets showed the existence of a mass of air pushed along in front of the bullet. Is there anything analogous to this in the electromagnetics of an electron? Suppose, for example, that an electron is jerked away from an atom so strongly that its speed exceeds that of light. Then it will slow down by reason of the resisting force to which I have shown it is subjected. So long as its speed is greater than that of light, it is accompanied in its motion by a conical wave. The question is whether there is any disturbance ahead of the electron, close to it, as in the case of a bullet moving through the air. It is a question of fact, not of theory. When Maxwell's theory shows that there is no disturbance in front of the electron, that is only because it is virtually assumed to be so at the beginning, by the assumption that the ether continues fixed when the electron traverses it.

Apart from this detail, the analogy between the conical sound wave and the conical electromagnetic wave is interesting in connection with C. A. Bjerknes's theory of pulsations in a liquid, as developed by V. Bjerknes in his "Vorlesungen über hydrodynamische Fernkräfte nach C. A. Bjerknes' Theorie." The liquid is incompressible, and is set into a pulsating state by pulsating sources, and the result shows remarkable analogies with electric and magnetic phenomena when they are static.

Now if the liquid is compressible, the results must be approximately the same provided the pulsations are not too quick. But if very rapid, and the compressibility be sufficient to lower the speed of propagation sufficiently, new phenomena will become visible with pulsating sources, like sound waves, and the question is how far they are analogous to electromagnetic phenomena?

Here, for example, is an interesting case. Let f be the density of the source, such that (if $q = d/d(vt)$),

$$(\nabla^2 - q^2)V = -f \qquad (1)$$

is the characteristic of the velocity potential V, so defined that $-\nabla V$ is the velocity. Then f signifies the amount of fluid (unit density) generated per unit volume per second and diverging outward. Then, for a point source of strength Q, the V it produces is

$$V = \frac{\epsilon^{-qr}}{4\pi r}Q = \frac{Q(t - r/v)}{4\pi r}, \qquad (2)$$

at distance r. This is equivalent to Rayleigh's account of Helmholtz's spherical waves from a centre ("Theory of Sound," vol. ii.), except in the interpretation of f or Q, which I do not altogether understand in that work.

Q is a fluctuating function of the time in the above in the acoustic application, though, of course, fluctuation is not necessary in the ideal theory. Now if the source Q moves through the air with velocity $\mathbf{u}$, the potential becomes

$$V = \frac{Q}{4\pi r\{1 - (u/v)\cos\theta\}}, \qquad (3)$$

if θ is the angle at Q between $\mathbf{r}$ and $\mathbf{u}$ at the proper moment.

This equation therefore expresses the theory of a very small pulsating source moved through the air, and is so far very like that of an electric charge Q (which does not pulsate) moved through the ether. The analogy does not continue in details, when, for example, we compare velocity with electric displacement. The electromagnetic theory is more involved.

When u exceeds v, equation (3) is no longer the complete solution. If u is less than v, there is just one and only one position of Q at a given moment where it is, so to speak, in communication with P, the point where V is reckoned. But when $u > v$, there may be just one point, or two, or there may be any number. Thus, if the source Q starts at moment $t = 0$ from a certain point, and then moves steadily in a straight line, the wave front is conical, with a spherical cap, or spherical, with a conical spike, Q being at the apex. If P is

inside the sphere, there is only one position for Q. But if P is inside the cone, there are two. The value of V at P is the same for both, given by (3) reckoned positive always. So the real V at P is double as much.

If the speed varies, the values of u will usually be not the same in the two positions, so the two partial V's must be separately reckoned. But the speed and path may vary in such a way that there are more than two positions of Q which are the centres of waves which all arrive at P at the same moment.

When there are any number of electrons moving about in given paths, the following will give a broad idea of the nature of the problem. To find V at a fixed point P at the moment t. Let at that moment a spherical surface expand from P at speed v, not forward in time, but backward. In expanding from radius 0 to ∞, it will cross the electrons one after another. Take note of the times of passage, t_1, t_2, &c. (less than t), of the charges and their velocities. Then

$$V = \Sigma \frac{Q}{4\pi R\{1 - (u/v)\cos\theta\}}, \qquad (4)$$

where $R_n = v(t - t_n)$, and θ_n is the angle at Q_n between $\mathbf{R}_n$ and $\mathbf{u}_n$. Similarly as regards the vector potential.

When u is allowed to exceed v, the effect is to increase the number of crossings of electrons. An electron crossed twice counts as two electrons.

The value of $\dot{t}_n$ is $\{1 - (u/v)\cos\theta_n\}^{-1}$. The vector $\mathbf{u}_n$ is the real velocity of Q_n at the moment t_n. Its apparent velocity, as viewed from P at the moment t, is $\mathbf{u}_n\dot{t}_n$ or $-\dot{\mathbf{R}}_n$. It has no necessary resemblance to the real velocity, and may be positive or negative. The dot here signifies differentiation to t at P.

Talking of potentials, I am tempted to add a few words about their King, the Pan-potential. In equation (1) above, let q be not $d/d(vt)$, but any sort of complex time differentiator, for example, if $p = d/dt$,

$$q^2 = (k + cp)(g + \mu p),$$

which is the special form for electromagnetic waves in a conductor. Then (2) is still the solution for a point source, and in general

$$V = \Sigma \frac{\epsilon^{-qr} f}{4\pi r} = \text{pan} f \qquad (5)$$

is the pan-potential due to the distributed source f. It is not the complete solution, because ϵ^{qr} has not been counted; but that is not wanted when there is no barrier to reflect.

For instance, if $\mathbf{C}$ is *impressed* electric current, in a conductor, the characteristic of $\mathbf{H}$, magnetic force, is

$$(\nabla^2 - q^2)\mathbf{H} = -\text{ curl } \mathbf{C}. \qquad (6)$$

It follows by the above that

$$\mathbf{H} = \text{pan curl } \mathbf{C}, \qquad (7)$$

that is, the magnetic force is the pan-potential of the curl of the impressed current. The operations pan and curl are interchangeable, so

$$\mathbf{H} = \text{curl pan } \mathbf{C}, \qquad (8)$$

i.e.,

$$\mathbf{H} = \text{curl } \mathbf{A}, \qquad \text{if} \qquad \mathbf{A} = \text{pan } \mathbf{C}.$$

(Similarly ∇ pan = pan ∇, and div pan = pan div.)

I worked out this problem for a fixed point source of impressed current some time ago ("Elec. Pa.," vol. ii. p. 432) without reference to the pan-potential. The operational solution there given, equation (258), represents either (7) or (8). The algebrisation was also done. There is no advantage in using the $\mathbf{A}$ function in this particular case; it is, in fact, more difficult to find $\mathbf{A}$ first and then derive $\mathbf{H}$ than to obtain $\mathbf{H}$ without $\mathbf{A}$. Similarly as regards $\mathbf{E}$, the electric force. The second circuital law derives it from the $\mathbf{H}$ equation, so that it is not required to introduce Φ to supplement $\mathbf{A}$.

If the point-source is in motion, the pan-potential requires Dopplerisation as well as the ordinary potential. But this does not require explicit representation for continuously distributed sources. For example, the electromagnetic circuital equations

$$\text{curl } (\mathbf{H} - \mathbf{h}) = \mathbf{u} \text{ div } c\mathbf{E} + (k + cp)\mathbf{E}, \qquad (9)$$

$$\text{curl } (\mathbf{e} - \mathbf{E}) = \mathbf{w} \text{ div } \mu\mathbf{H} + (g + \mu p)\mathbf{H}, \qquad (10)$$

where $\mathbf{u}$, $\mathbf{w}$, $\mathbf{e}$, $\mathbf{h}$ are functions of position and time, have the solutions

$$\mathbf{E} - \mathbf{e} = \text{pan } \mathbf{X}, \quad \mathbf{H} - \mathbf{h} = \text{pan } \mathbf{Y}. \qquad (11)$$

To prove this, and determine the nature of $\mathbf{X}$ and $\mathbf{Y}$, it suffices to put the characteristics of $\mathbf{E} - \mathbf{e}$ and $\mathbf{H} - \mathbf{h}$ in the form (1), q^2 having the more general later meaning. Now (9) and (10) lead to

$$(q^2 - \nabla^2)(\mathbf{E} - \mathbf{e}) = \nabla\rho - \text{curl } \mathbf{G} - (g + \mu p)\mathbf{C}, \qquad (12)$$

$$(q^2 - \nabla^2)(\mathbf{H} - \mathbf{h}) = -\nabla\sigma + \text{curl } \mathbf{C} - (k + cp)\mathbf{G}, \qquad (13)$$

where

$$\rho = \text{div } (\mathbf{E} - \mathbf{e}), \quad \sigma = \text{div } (\mathbf{H} - \mathbf{h}), \qquad (14)$$

$$\mathbf{C} = \mathbf{u} \text{ div } c\mathbf{E} + (k + cp)\mathbf{e}, \qquad (15)$$

$$\mathbf{G} = \mathbf{w} \text{ div } \mu\mathbf{H} + (g + \mu p)\mathbf{h}. \qquad (16)$$

So $\mathbf{X}$ and $\mathbf{Y}$ are the right members of (12) and (13) as defined. $\mathbf{C}$ is the impressed electric current, $\mathbf{G}$ the impressed magnetic current. It will be seen that no separate determination of scalar potentials is required, because they are already included in $\mathbf{X}$ and $\mathbf{Y}$.

OLIVER HEAVISIDE.

Recent Dust Storms in Australia.

ON November 11, 12 and 13, 1902, New South Wales and Victoria experienced severe dust storms, apparently caused by a mild cyclone travelling from the west, as the dust reached here yesterday morning, the wind at the time being very light. The atmosphere was so loaded with fine dust that the sun looked dim and objects less than a mile away were quite indistinct, and all furniture, even with doors and windows closed, became coated with a fine grey deposit.

Reports from vessels coming along the coast say that the sea had a peculiar leaden colour; and a remarkable appearance was seen in Sydney Harbour yesterday morning. Crossing the harbour from the north to the south side, immediately on getting in sight of the sun the wavelets between the steamer and the sun showed streaks of brilliant light metallic blue colour. This was intensified when the boat entered the still glassy water of Sydney Cove, when the back of each ripple caused by the steamer on the sunny side showed a sheet of the same colour and that most brilliantly. The water where undisturbed was covered by a slight scum, which might either be settled dust or a layer of mineral oil, but appeared more like the former. The colour had not the iridescent appearance caused by oil, as it was a uniform pale blue and only showed on the back of the wavelets.

It seemed to me that this was an exaggerated example of the blue colour of water caused by finely-divided mineral matter seen in glacier waters and those of the hot lakes of New Zealand, where the water has silica in suspension.

WILL. A. DIXON.

97 Pitt Street, Sydney, November 14, 1902.

ABOUT half-past four o'clock on the afternoon of November 12, I noticed that the sky to the north and north-east, from the horizon half-way to the zenith, had assumed an extraordinary chocolate-brown tint, due to clouds of that colour which were moving towards us from the north-west. Under these clouds, and moving from the north-east, were ashy-grey patches of stratus, streaked with fantastic dark lines resembling bows and boomerangs. A few drops of rain which fell about five o'clock were charged with brown, earthy matter, and at six o'clock a paper which was held in the rain became spotted all over with brown blotches.

This fact, and the colour of the clouds, led me to the conclusion that a tornado had taken place in the interior of Australia, whirling the fine dust high into the upper regions of the atmosphere, in which position it was carried over the Straits and then descended with the rain.

At 6.20 p.m. the solid matter was still descending, but in less quantity; at 6.30 there was a marked diminution; and by ten minutes to seven the rain was all but free from it.

While the six o'clock shower was descending, one heard the remark on all sides that "it was raining mud"; those who were unfortunate enough to have their week's washing hanging out at the time were doomed to a second day at the wash-tub.

This remarkable occurrence recalls the events of Black Thursday, 1851, when Victoria was swept by tremendous bush-fires; leaves and portions of charred ferns were carried up to great heights by the currents of heated air, wafted across Bass' Straits and deposited upon our shores; the sky was so darkened by huge volumes of smoke that, although in the height of summer, lamps had to be lit early in the afternoon.

H. STUART DOVE.

West Devonport, Tasmania,
November 14, 1902.

A Sickle Leonid.

AT 2h. 17m. on Sunday morning, December 21, I witnessed the passage of a swift, streak-leaving meteor, magnitude 1, duration about 0·75 second. It proceeded from γ of Cancer and disappeared near to λ of Gemini. On tracing its path backward, I found its radiant to be in the well-known Sickle of Leo.

G. MCKENZIE KNIGHT.

25 Holford Square, London, W.C.

THE BABYLONIAN AND ASSYRIAN LEGENDS OF THE CREATION.[1]

IT is now a little more than thirty years ago since the learned world was startled by the announcement that Assyriologists had discovered a remarkable version of the history of the Creation, which closely resembled the narrative of the first chapter of the Book of Genesis, and appeared to be based upon the archetype from which one of the earliest editors or writers of the Pentateuch drew many of his statements. The interest shown in the discovery of the Babylonian and Assyrian account of the Creation was widespread, and though it did not equal that displayed by the learned world in the story of the Deluge as unfolded from the cuneiform records by the late Mr. George Smith, it was sufficiently important to move Assyriologists to further exertions and to provide them with a public which has been ever ready to welcome the results of their labours with toleration and praise. The credit of the discovery of the cuneiform Creation records in the British Museum belongs, undoubtedly, to Sir Henry Rawlinson, and it must even be a subject for lament that his official occupations prevented him from laying his work before the world in a suitable manner many years before his assistant, Mr. George Smith, was able to do so. In the preface to the work before us, Mr. L. W. King, of the British Museum, has continued, and, we are glad to add, completed, as far as is possible at present, the work which was begun by Sir Henry Rawlinson, and he presents to us the whole of the available material in a form handy to use and easy to study.

The first volume of the "Seven Tablets of Creation" contains a useful preface, a good introduction, and transliterations into English letters of all the cuneiform texts, with clear translations arranged opposite them; five appendices, an index and a glossary complete the volume. In the second half of the work, we have the original cuneiform texts, and as they are written in a good, bold hand, the curious reader will find no difficulty in verifying any of Mr. King's statements. After sketching briefly the services which have been rendered by earlier editors of the Creation legends, Mr. King passes on to describe the new material which he has found as the result of several examinations of the collections of clay tablets from Kuyunjik now in the British Museum. In the thirteenth part of "Cuneiform Texts," published by the Trustees of the British Museum in 1901, Mr. King gave copies of a number of documents relating to the Creation, among them being several which, though used by previous workers, had not been published, and one which had been consulted by Mr. Smith in 1876, but had been apparently lost sight of. Great credit is due to Mr. King for identifying this last-mentioned important fragment, for, so far as we have been able to discover, it was not recognised by Dr. Bezold, who, in his "Catalogue of the Konyunjik Collection" (p. 998, K. 9267), describes it merely as "part of a mythological legend." Whilst, however, Mr. King was searching for fragments of other Babylonian legends, he discovered so many new portions of the Creation legends and duplicates that he decided to write a monograph on the subject, and as the result of his labours we are now able to form a connected idea of the whole of the Babylonian story of the Creation. Formerly, only twenty-one tablets and fragments inscribed with portions of the legend were known, but now no less than forty-nine separate tablets and fragments have been identified as containing portions of the cuneiform texts of the Creation series. In fact, Mr. King has identified twenty-eight new portions and duplicates of Creation texts, and the details of the great story can now be followed consecutively, a thing which, up to the present, has been impossible.

We now know that the great Babylonian poem of Creation was divided into seven sections, or tablets, and that the whole work was known by the title "Enuma Elish," which also forms the opening words of the text,

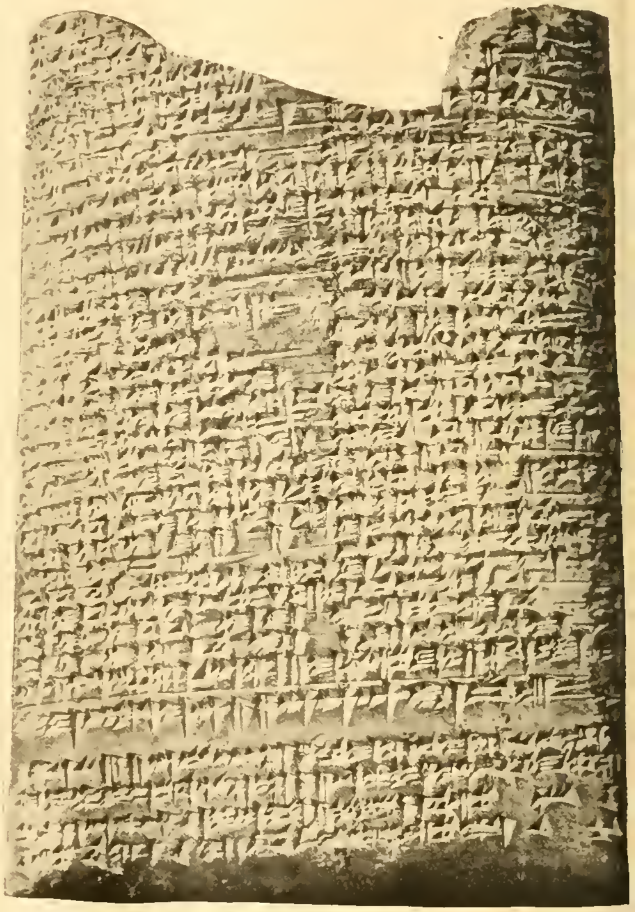

FIG. 1.—Part of the Fourth Tablet of the Creation Series (Brit. Mus., No. 93,016).

and that it contained nine hundred and ninety-four lines; those who are interested in ancient theories of numbers will note that 994 is a multiple of 7. Each of the seven sections on tablets contained, on an average, one hundred and forty lines, and it is clear that each tablet was intended to describe the events of one "day" of creation. It is difficult not to think that such artificial divisions of the legend indicate that we are dealing with a comparatively late recension of it, and this may well be the case when we remember that the oldest copies of it which we possess date from the reign of Ashur-bani-pal (B.C. 668-626); no one who takes the trouble to read the seven tablets and who is familiar with ancient cosmogonies and theogonies will have the slightest doubt that

[1] "The Seven Tablets of Creation." By L. W. King. Vol. i. English translations. Pp cxxiv + 274. Vol. ii. Pp. xiii and 84 plates. (London: Luzac, 1902.)

the original form of the Babylonian and Assyrian history of Creation is many thousands of years old. Whether it originated with the Akkadians or some other non-Semitic people cannot be said definitely at present, but it is very probable that the Semitic Babylonians were only the borrowers and not the inventors of this remarkable work.

We may now note the main heads of the legend. At the beginning of all things, Apsû and Tiamat were water deities and typified chaos; to these were born Lahmu and Lahamu, and later appeared Anshar and Kishar, and still later Anu and other gods came into being. One of the newly-found fragments of the first tablet mentions the birth of Nudimmud (Ea), and although Damascius states that Bēl, the creator of the world, was the son of Ea and Damkina (Ἀός, Δαύκη), it is clear from the fragment that Marduk, who is made to take the leading part in the later tablets of Creation, was supposed to be in existence, like Mummu and Gaga. In the earlier episodes of the Creation story, it is Ea and not Marduk who is the hero, and we learn for the first time, from the new material, that it was Apsû, a god of chaos, and not Tiamat who rebelled against the gods. Apsû disliked the new order of things and the creation of the universe for the simple reason that the beings who formed members of the new world disturbed his peace and rest; as soon as he had made up his mind as to what was likely to happen, he called Mummu his minister (the Μωϋμὶς of Damascius), and the two went to Tiamat and took counsel with her, and complained that "he could get rest neither by day nor by night." The putting of the house of the world into order by the gods destroyed his rest and peace of mind. Of the conflict which took place between Ea and Apsû and his ally Mummu we know little, but that the great god did not succeed in inflicting a decisive defeat on Apsû and his allies is clear from the fact that, later, Anshar found it necessary to exhort Marduk to do battle with Tiamat. Of the defeat and death of Tiamat we need say little, for the story of how the god of light slew her and split her body into halves is familiar to all. The actual account of the creation of the world by Marduk begins towards the end of the fourth tablet, where it is said that one-half of the body of Tiamat formed a covering for heaven, and that Marduk, having formed E-shara, made the great trinity of Anu, Bēl and Ea to dwell therein.

In the fifth tablet, we hear of the fixing of the constellations of the Zodiac, the founding of the year, &c., and it seems as if this section contained an account of the creation of vegetation. The sixth tablet, as we know from one of the new fragments, told the story of the creation of man, and it seems as if Marduk made man with the view both of punishing the gods and of providing a creature who should at all times worship him. Marduk, or Bēl, instructed Ea to cut off his (*i.e.* Marduk's) head, and man was formed out of the blood which flowed from the god's body. Marduk is made to tell Ea that he intends to create man from his own blood and from the "bone" which he will create; it is important to note that the Assyrian word for "bone" is *issimtu*, and that it is the exact equivalent of the Hebrew *'esem*, "bone," which occurs is Genesis ii. 23, in connection with the account of the creation of woman.

The creation of man was the final act of creation, and when this was accomplished the gods assembled in their council chamber in Upshukkinaku, with Marduk at their head, and they sang to him a hymn of praise, the text of which forms the seventh section of the Creation story and contains fifty addresses to the god. How Marduk managed to survive his decapitation is not told us, and we can only surmise that he met the gods in their council chamber in some sort of spiritual body. The space at our disposal will not allow us to call attention to many very interesting details of the legend, especially in the parallels which may be drawn between parts of it and the Book of Genesis; these prove beyond all reasonable doubt that the Jews borrowed large portions of their religious literature from their kinsmen the Babylonians, and that the seven days of Creation were imagined long before the days of the patriarch Abraham. The student of comparative folklore will find much to interest him in Mr. King's latest work, and will perhaps trace the mingling of legends illustrated in it with somewhat mixed feelings. Mr. King's texts are carefully edited and well copied, and his translations, which we have examined in several passages, are faithful and not unduly literal, and his work is a credit to English Assyriology.

A POT OF BASIL.

THERE is a widely spread belief, both amongst natives and amongst the white sojourners in Western Africa, that the presence of a certain species of plant in a room drives away mosquitos, and, in fact, a single plant is said to be sufficient to clear a room. On his recent return from Northern Nigeria, Major J. A. Burdon, of the Cameron Highlanders, brought with him and gave to me a few leaves of this plant. These, through the kindness of Mr. H. H. W. Pearson, have been identified by the experts at Kew as belonging to *Ocimum viride*, Willd., a member of the order Labiatæ, which occurs from Senegambia southwards to Angola.

Major Burdon, who is Resident of the Nupe Province, Northern Nigeria, and Hausa Scholar of Christ's College, Cambridge, has given me the following account of the plant:—

"A fragment of what turns out to be *Ocimum viride* was given me in August last at Lokoja, Northern Nigeria, by Captain H. D. Larymore, C.M.G., R.A., Resident of the Kabba Province. Capt. Larymore's notice had been drawn to the plant by a native living in a low-lying part of the native town at Lokoja, who had told him that the natives suffered very little from the swarms of mosquitos which existed in that part, as they protected themselves from them by the use of this plant.

"Capt. Larymore made inquiries and obtained a few specimens of the plant, which grows wild, though not very abundantly, in the neighbourhood of Lokoja. These specimens he planted in pots and boxes and kept in and about his house. The specimens I saw were about the size of a geranium.

"He informed me that the presence of one of these plants in a room undoubtedly drove the mosquitos out, and that by placing three or four of the plants round his bed at night he was able to sleep unmolested without using a mosquito net. This is very strong testimony to the efficacy of the plant, for the house in which Capt. Larymore was living is, as I had cause to know well in former years, infested with mosquitos."

In the fifth volume of Sir W. T. Thiselton-Dyer's "Flora of Tropical Africa," *Ocimum viride* is described as follows:—

"*O. viride*, Willd.; Benth. in DC. Prod. XII. 34. A perennial 3–6 ft. high, with much-branched glabrous stems. Leaves distinctly petioled, oblong, acute, membranous, 3–4 in. long, glabrous on both sides, or obscurely pubescent beneath. Racemes lax, copiously panicled, 3–6 in. long; rhachis finely pubescent; bracts deciduous; pedicels not very short. Calyx $\frac{1}{6}$ in. long; tube campanulate; upper lobe orbicular, as long as the tube; lower teeth short. Corolla half as long again as the calyx-lobes. Stamens but little exserted, the two upper with filaments toothed above the base.—Benth. in Hook. Niger Fl. 488; Henriques in Bolet Soc. Brot. X. 149. *O. febrifugum*, Lindl., in Bot. Reg. t. 753. *O. heptodon*, P. Beauv. Fl. Owar. II. 59. t. 94."

The plant is figured on plate 753 of the ninth volume

of the Botanical Register, 1823, under the name *Ocymum febrifugum*, or the "Sierra Leone Fever Plant." This work mentions that the plant is "in request at Sierra Leone for medicinal purposes," and describes the species as an "*under shrub* 3 feet high," "having in a high degree the smell of common balm."

The leaves of the plant are highly glandular, and in India an allied species, *O. Basilicum*, Linn., the "common sweet basil," produces a "yellowish green volatile oil lighter than water, which, on being kept, solidifies into a crystalline camphor, isomeric with turpentine camphor" (*Gmelin's Handbook*, xiv., 359).[1] The seeds of this species are widely used in the

FIG. 1.—*Ocymum viride*, Willd. Some leaves drawn from a dried specimen brought back by Major Burdon. Below is a raceme of the same plant taken from the "Botanical Register," vol. ix. Both reduced.

east as a medicine, and their properties "are said to be demulcent, stimulant, diuretic and diaphoretic." "The juice of the leaves mixed with ginger and black pepper is given in the cold stages of intermittent fever." The leaves, like those of thyme, are used as a seasoning in cooking. Another Indian species, *O. sanctum*, Linn., the "sacred basil," is the most sacred plant in the Hindu religion, and is consequently widely cultivated.

In "Notes on the Medicinal Plants of Liberia,"[2] Mr. E. M. Holmes records that when chewed or rubbed, the leaves of *O. viride* give off a strong odour of lemon thyme, and mentions that Dr. Roberts, of Liberia, entirely substituted the use of the plant for that of quinine in cases of fever of all kinds, giving it in the form of an infusion.

There is thus a good deal of evidence that *O. viride* is a plant of considerable curative value, especially in cases of fever, but the question that interests a large number of people in West Africa is whether it is equally efficacious as a preventative. Does it really repel the mosquito which acts as the intermediary in conveying the malarial hæmatozoon from man to man? Further experiment on this point is needed, but there is at least some indication that in this easily cultivated plant man has another weapon with which to fight malaria.

Christ's College, Cambridge. A. E. SHIPLEY.

[1] Watts's "Dictionary of the Products of India," v. 1891, p. 441.
[2] *The Pharmaceutical Journal*, third series, viii. 1877–78.

TRANSATLANTIC WIRELESS TELEGRAPHY.

THE announcement of the successful inauguration of the Transatlantic wireless telegraphic system which we were able to make last week must have come as welcome news to all, but hardly as a surprise to those who have followed with any closeness Mr. Marconi's persevering experiments. Those who have done so and who have seen how, in almost every instance, Mr. Marconi has achieved all that he has said he would achieve can hardly have doubted that in this case also he would be successful. And when once it had been demonstrated that Hertz waves were capable of bridging the enormous distance from the Old World to the New, it was evidently only a matter of time to instal suitable stations on both sides of the Atlantic and to put them in operation. Nevertheless, the greatest interest attaches to the transmission of the first messages; one cannot help feeling that it is an historic occasion, not only marking an era in the development of wireless telegraphy, but also forging another link between this country and her colonies, and adding yet one more to the many benefits helping forward civilisation which science has conferred on mankind.

As yet, of course, not much has been done; a few congratulatory telegrams have passed from one side of the Atlantic to the other, and doubtless there will have to be much more experiment and work before a commercially useful system of communication is established. But for this we can wait in patience and confidence. It is easy to see that, though the possibilities are many and great, the difficulties also are formidable and numerous. In the first place, before the system can be commercially important, it is clear that the public must be made to feel confident that it is absolutely trustworthy; any uncertainty in this respect would be fatal to a system which has to make its way against the competition of existing methods. Again, the system is, for the present at any rate, limited in its carrying capacity, since the speed of signalling obtainable is not very great, and from what can be gathered it seems unlikely that multiplexing to any great extent, or even at all, can be regarded as a possibility of the near future. From another point of view also difficulties present themselves, for we have yet to learn what effect will be produced on existing wireless installations by a constant stream of very powerful Hertz waves sent out on either side of the Atlantic. If the Transatlantic signalling seriously interferes with the less pretentious applications of wireless telegraphy, there can be little question as to which it is more desirable to retain. But all these problems we may safely leave for the present, for we know that they are in the hands of one who has shown himself fully competent to deal with them.

Whatever else may be said of his present achievement, all must agree that it is a great personal triumph for Mr. Marconi, and one that he has fully merited by his untiring

perseverance and endeavour in the face of difficulties, opposition and adverse criticism that would have daunted many. Great indeed as the advances in wireless telegraphy have been when regarded simply as advances in applied science, few things are more remarkable than the rapidity with which they have been made. It is less than ten years since the first experiments were made in the application of Hertz waves to signalling. Mr. Marconi himself began work a few years later—in 1896. In that year he was able to transmit signals over a distance of a mile or so, and ever since he has been steadily increasing the limit until, about one year ago, it was announced that the signal "S" had been transmitted from Cornwall to America. Many who were sceptical of this result at the time must have been convinced of its genuineness when a little later (last March) messages were transmitted to the *Philadelphia* up to a distance of 1551 miles from land and the signal "S" transmitted to a distance of 2099 miles. Following on this came the cruise of the *Carlo Alberto* during July, August and September last, when extremely successful results were obtained over great stretches of land and water. Finally, at the close of 1902, we have the inauguration of a complete Transatlantic system with transmission of messages in both directions. No one can consider this as other than a splendid record for six years' work.

Little need be said of the stations on either side of the Atlantic, since both have been already described and illustrated in NATURE (see vol. lxv. p. 416, and vol. lxvi. p. 485). It is to be hoped that before long we shall be able to record that both have been in continuous and successful commercial working without producing any ill effects on other installations. When this has been accomplished, the problem of syntony remains to be solved, and we wish Mr. Marconi the same complete success in dealing with this problem as has crowned his other efforts. MAURICE SOLOMON.

A SUB-TROPICAL SOLAR PHYSICS OBSERVATORY.

WE have received from a correspondent in America the following letter by Prof. S. P. Langley, secretary of the Smithsonian Institution, suggesting the establishment of a great solar observatory in or near the tropics. Referring to the practical value of such studies of the sun as are suggested by Prof. Langley, our correspondent remarks:—"It is an amazing thing that the enormous utility of recent work on the sun's connection with the conditions which bring famine or plenty to India, for instance, is lost sight of by almost all astronomers. Astronomers and astrophysicists, even, are apt to look at it in its purely scientific interest, as if it had none other than what it might share with the discovery of the motion of a nebula."

The letter sent by Prof. Langley to the Hon. Charles D. Walcott, secretary of the Carnegie Institution, is given in the report of the executive committee to the trustees of the Carnegie Institution, published November 26, 1902, and reads as follows:—

February 28, 1902.

DEAR MR. WALCOTT,—You were saying to me that you knew of some persons who might be desirous of aiding, through the Smithsonian Institution, some large object, and I was led to write you what is in substance the following letter:

I learn from yours of February 14 that you would like to call it to the attention of the executive committee of the Carnegie Institution, and, as I have written, I shall be very glad to have you do so, asking you to make it clear that it is in no way a request from the Smithsonian Institution, but a suggestion from me of a great object which Mr. Carnegie himself may care to take up.

I do so the more readily because, considering the Institution wholly apart from its own needs, it would be the glad means of indicating to those who wish some worthy aim for expenditure, some specific object, which may be undertaken if desired *in their own name* and through any worthy medium they prefer.

One of these is the determination of the heat the sun sends the earth and the causes of its probable variation. The progress of solar physics has been such in the last few years as to make it of interest to every inhabitant of the planet that this progress should be carried further, not only in scientific, but in economic, and in even humanitarian interests.

The establishment of a great observatory in the tropical or sub-tropical regions at a high altitude would advance our knowledge of the heavenly bodies in a degree more than could be done by all the physical observatories in the world united. To the founder of such an observatory there would be enduring fame, but it is an affair of a very great deal of money, possibly to be reckoned only in millions. The establishment and maintenance for eleven years of a distinctly solar observatory under these conditions would enable us to study the sun as it has never yet been studied, and through an entire solar cycle, for much less cost.

While this latter research, then, is to be pursued at less cost than the foundation of a great general observatory, it has a specific object of literally world-wide importance and interest.

The determination of the heat the sun sends the earth annually is the determination of that through which everything on the planet lives and moves, and almost unknown slight variations of this heat are the probable, if remote, cause of the changing character of the seasons and of the lack or plenty in the crops upon the earth as a whole.

It has seemed possible within the last few years that if we had this knowledge, the years of plenty and of famine could be forecasted as we now forecast a coming storm through the advices of the Weather Bureau. It is possible, I say, but I do not wish to say more than that it is possible.

I do not know any greater or more worthy object for the expenditure of 500,000 dollars than the settlement of this latter great question would be. It is, with our present knowledge, almost a question of money; but no Government is prepared to spend such a sum except for its own interest. This is for the interest of all the people in the whole world, and I entirely concur with the recommendation of its importance from the chief of the United States Weather Bureau, which I enclose. I should gladly see it undertaken, whoever does it.

Very truly yours,

S. P. LANGLEY.

The Honorable CHARLES D. WALCOTT.

In a further letter, sent on October 20 to Prof. G. E. Hale, who asked for details of the proposed scheme of work and equipment, Prof. Langley described the principal objects of inquiry of a distinctly solar observatory, the plan of observations, and apparatus and accessories required.

NOTES.

THE management of the Imperial Institute will from January 1 be vested in the Board of Trade, assisted by an advisory committee representing various Government Departments and the Indian and Colonial Governments. The Board of Trade has appointed Prof. Wyndham Dunstan, F.R.S. (now director of the scientific and technical department of the Institute), to be Director of the Imperial Institute. Prof. Dunstan will continue in charge of the scientific investigation of economic products, and will supervise any other branches of work carried on by the Board of Trade in the building at South Kensington, including the collections of products of the Empire so far as they will be under the control of the Board. These arrangements do not affect the parts of the collections and the information offices under the special charge of representatives of the India Office and of certain Colonial Governments.

IN consequence of the presentation of a memorial in favour of the admission of women to the fellowship of the Linnean Society, the council issued a circular in March last inviting an expression of opinion on the part of the whole body of fellows. The result has been that 301 fellows have pronounced in favour

of the proposal and 126 against it, whilst 313 fellows gave no reply. This expression of opinion is considered sufficient to justify further action; accordingly the matter will be brought before a special general meeting on January 15. As the existing charter gives no power to the society to admit women as fellows, a resolution will be moved to obtain a supplemental charter for this purpose.

IN consequence of frequent cases of sickness and death caused by poisonous substances in salted raw fish used for food, the committee of the Caspian fishery and seal industries several years ago offered a prize for the investigation of the nature of the fish-poison, for indications of the methods of preventing fish from becoming poisonous, and for the healing of persons poisoned by fish. The accumulated interest and capital now amount to 7500 roubles (about 1050*l.*). The Imperial Academy of Sciences, St. Petersburg, acting with the Ministry of Agriculture and Crown Domains, have now issued particulars of a new competition on the nature of fish poison and the antidotes. The persons competing for the award offered in the interest of public health will be expected to offer solutions of the following problems:—(1) By careful experiments to define the qualities of poison contained in fish; (2) to investigate the action of the poison of the independent organs of animal bodies, the central nervous system, the heart, the circulation of blood and the digestive organs; (3) to present an accurate illustration of the pathological reactions in the various parts of animal and human bodies caused by such poisoning; (4) to present a description of the signs serving to distinguish fish containing poison from normal fish; (5) to indicate methods for the prevention of development of poison in fish; (6) to indicate antidotes and general provision against poisoning by fish. The awards for the competition will be three premiums, viz. 5000 roubles (700*l.*), and two of 1500 roubles (210*l.*) and 1000 roubles (140*l.*). The two lesser prizes may be gained should the author solve only a part of the problem, basing his experiments upon one method of science—chemistry, physiology or bacteriology. As regards the larger prize, this will be awarded only for the work which covers the problem of the nature of the fish-poison in all respects. The work sent in to compete for the awards may be written or printed in Russian, Latin, French, English or German, and should be submitted by October 1, 1903, to the Ministry of Agriculture and Crown Domains.

MR. N. F. DOBRÉE, of Beverley, has presented his collection of European Noctuæ to the Hull Municipal Museum. This collection contains more than five thousand specimens and is one of the finest in the country.

THE death is announced of Prof. Richard Baron Von Krafft-Ebing, professor of psychiatry at Vienna and author of works on psychiatry and physiological psychology.

WE regret to announce that Mr. Otto Hilger, the well-known astronomical and optical instrument maker, died on December 18, at fifty-two years of age.

MR. A. CARNEGIE has expressed to the Provost of Greenock his willingness to present to a properly authorised authority in the town the sum of 10,000*l.* to defray the cost of the erection of a memorial to James Watt; or he is willing to head a movement in America to raise a large fund which, added to what might be subscribed in Great Britain, would enable a wider scheme for a memorial to be arranged.

ONE of the subjects discussed at the recent conference of Colonial Premiers was that of an Imperial Patents Act whereby one patent would cover the whole Empire. Mr. G. C. Douglas, writing to the *Times* of December 30, points out that such a measure would help enormously in the building up of industrial concerns. In the United States of America, one patent covers a territory with an industrial population of about seventy millions, whereas it takes about forty patents to protect an invention in the British Empire. If it were decreed that one patent covered Great Britain, India and the various other dependencies, our great self-governing Colonies would probably soon unite with the Government to make the reform an Imperial one.

A REUTER telegram from Syracuse states that shortly after eight o'clock in evening of December 28 a severe shock of earthquake was felt, preceded by subterranean rumbling.

A REUTER telegram from St. Thomas on December 27 reports that a violent eruption of Mont Pelée was in progress at 10.30 that morning. Dense grey smoke and dust were pouring out to a great height. Advices from other sources state that the cone of the volcano was luminous at night.

PROF. LACROIX, the conductor of the French scientific expedition sent to Martinique, has, *La Nature* says, reported to the Colonial Minister an account of the consequences of the shattering of the cone formed in the crater of Mont Pelée. Blocks of incandescent lava rolled in the direction of the White River and filled it. Volcanic material six kilometres from the crater, which had collected in the neighbouring valley, had eight days after the eruption a temperature exceeding 100° C. On December 15, symptoms premonitory of an eruption were experienced at Kingston, St. Vincent, and on December 18 a new eruption occurred, but caused no accident.

A REUTER'S telegram from the scene of the recent earthquake at Andijan, dated December 23, states that the shocks continue and are daily increasing in violence.—December 26, *Ashkabad.* Oscillations of the earth are still noticeable. In Andijan and neighbourhood, 15,000 houses have been destroyed. Andijan as a town has existed for 400 years, and has already been visited by earthquakes.—December 28, *Ashkabad.* A long and violent earthquake shock was felt at Andijan at 10 p.m. yesterday.—December 29, *St. Petersburg.* The earthquake at Andijan on December 16 extended over an area of nearly seven hundred square miles. The epicentrum of the disturbance has been located about four miles to the south of Andijan. It is indicated by a rent made in the earth from which sand, water and mud are thrown up. The statical wave was about 28 inches high, and took a northerly direction.

WE learn from *Science* that Prof. H. V. Hilprecht has been awarded the Lucy Wharton Drexel medal of the University of Pennsylvania for his archæological researches.

AT the concluding meeting of the Egyptian Medical Congress on December 24, it was held that the international rules applying to plague and cholera required revision, and the wish was expressed that an international congress should meet forthwith to lay down rules in accord with the demands of science.

WE learn from *Science* that the Carnegie Institution of Washington has made a grant of 500 dollars to Prof. Bancroft, of Cornell University, for a systematic study of the bronzes; an annual grant of 10,000 dollars to revive the "Index Medicus," formerly published under the direction of Dr. J. S. Billings; and a grant of 1000 dollars to the astronomical department of Vassar College to enable Dr. Caroline E. Furness to make measurements and reductions of photographs of the stars in the region of the north celestial pole.

AT the dinner on December 22 to Major Ronald Ross, in honour of his being awarded the Nobel prize, the Lord Mayor of Liverpool dispatched a telegram to the King. The following message was received in reply:—"I have submitted your telegram to the King and I am commanded, in reply, to request you to congratulate Major Ross on the honour which has been conferred upon him by the King of Sweden.—KNOLLYS."

AN expedition sent by the New York Botanical Garden to Nova Scotia and Newfoundland has secured, the *Scientific American* states, 12,000 specimens of more than 2000 species of plants. A third of the specimens are marine plants. Another expedition sent to north Montana by the same enterprising institution has done much in the interest of scientific botany. Many alpine forms of plants were discovered. Ample statistics were secured establishing the variation of plant life caused by temperature and latitude, and of the general vertical distribution of flora.

REFERRING to Mr. Backhouse's letter on sunset glows in last week's NATURE (p. 174), the Rev. G. J. Bridges, writing from Salisbury, says:—"In addition to the colour growing less vivid, the 'colouring' does not occupy so much space as in the Krakatoa glows. It occurs much sooner after sunset and much nearer sunrise than in the case of those which occurred in 1883. . . . The dust wisps are so much more defined of late that it is difficult to distinguish them from faint streaks of strata except by position, which appears to be always horizontal and corresponding to the curvature of the earth."

IN most of our colonies, more particularly those which are concerned with agriculture, the official botanical staff is no longer considered to be complete without a specialist in plant diseases. The reports and pamphlets embodying the researches of these specialists bear evidence of valuable and important work. An account of the fungus diseases which attack stone-fruit trees in Australia has been prepared by Mr. D. McAlpine. The principal diseases are described at some length and illustrated with very excellent coloured plates. These present diagnoses suited to the farmer whose scientific knowledge is limited, and methods of treatment are suggested and explained. Besides, there is added an account of many less common fungi also destructive to trees bearing stone-fruit, which presupposes a certain amount of botanical training.

THE report of the Director of the Botanic Gardens, Sydney, N.S.W., for 1901, besides dealing with matters appertaining to the Botanic Gardens, includes the improvements effected in the various public gardens which come under his control. An event of considerable importance was the opening of new buildings which had been erected in order to accommodate the National Herbarium and provide space for a botanical museum. The latter occupies one of three large rooms, while the other two are set apart for the cryptogamic and phanerogamic herbaria respectively. An interesting feature of the museum is a collection of local plants; also due prominence has been given to characteristic Australian plants, such as the Acaciæ, Eucalypti, various genera of the Proteaceæ, and Coniferæ. Reference is made to the trees planted by their Royal Highnesses the Duke and Duchess of Cornwall and York on the occasion of their visit to Sydney.

MR. F. C. CONSTABLE directs attention to the serious disadvantages of the common practice of hanging on the walls of schoolrooms maps of various countries of widely differing areas, all drawn to different scales, with the result that the countries appear, approximately, of the same size. One of the direct consequences of this custom is that comparatively few educated persons can give the relative sizes of, say, England and Africa, of Canada, Australia and British India, with any approach to accuracy. This defect in geographical teaching is by some teachers avoided by the use of wall-maps of the continents having printed in the corner a map of England to the same scale to serve as a key. It should not be difficult for teachers to prevent their pupils from obtaining an erroneous sense of proportion.

A DISEASE resembling "farcy," the cutaneous form of glanders, has been found to be prevalent in the Philippines. It is, however, not glanders, but is due to a blastomycetic parasite which can be detected in the lesions, and may be isolated and cultivated from these, though with some difficulty.

THE Punjab Government has been compelled temporarily to suspend its scheme for extensive inoculation against plague. A portion of the vaccine fluid became contaminated and induced tetanus in a small number of persons who were inoculated with it. During the month of October, no fewer than 120,000 people were voluntarily inoculated, and it had been intended to supply 70,000 doses of the vaccine fluid per diem had not this unfortunate mishap occurred.

SIR WILLIAM MACGREGOR, in an address delivered to the students of medicine of Glasgow University, dealt especially with the prophylaxis of malaria. As the outcome of his great experience, he recommended the preventive use of quinine in doses amounting to at least 15 grains a week. He stated that in Lagos the radical method of Ross for the extermination of mosquitos is being pursued by filling in the swamps with sandy soil. The large pools which cannot be drained at present have crude petroleum put on the surface periodically. Empty tins and similar rubbish are removed, and receptacles for drinking water are kept carefully covered. Native boys are now being employed as mosquito catchers, and should be upon the fixed establishment of every European resident in such a place as Lagos.

SIR CHARLES TODD has supplied the following notes on the rainfall during the past winter (April to September) in South Australia:—As compared with the average at thirty-seven selected stations distributed over the colony, the six months' fall is, without exception, far below the average amount. It is, in fact, one of the driest years ever experienced—so far as all the northern areas are concerned it is the driest—and the same applies to many parts of the south. At twenty-four out of the thirty-seven stations, the winter of 1902 is the driest on record, whilst at eight others only one other year was drier. At Adelaide, where the records go back to 1839, during the six months April to September, 1902, we have registered only 9·49 in., or 4·64 in. under the general average; in 1891, however, we only had 7·62 in. in the same time; in 1869, 8·73 in., and in 1876, 9·24 in., whilst in 1886 we recorded 9·43, about the same as in 1902, so that as regards the city that year is not a record.

MANY theories have been put forward to account for the so-called "black and white dot phenomenon" visible on diatom valves under high powers of the microscope. A discussion of several of these theories is given by Mr. Julius Rheinberg in the *Journal* of the Quekett Microscopical Club for November. After discarding the hypothesis of spherical aberration of the object on the ground that it does not fully account for the variations observed, Mr. Rheinberg gives reasons for his opinion that the effects are due to crossing of cones of light and darkness arising from total reflection beyond the critical angle between the mounting medium and the diatom. If this hypothesis is accepted, the dots on the diatom must be regarded as perforations the depths of which are greater than their breadth; this appears to be Mr. Rheinberg's view. Lastly, a diagram of the critical angles of different media relative to diatom silex and of the amounts of light totally reflected agrees fairly well with observation.

MESSRS. ELSTER AND GEITEL, in a recent number of the *Physikalische Zeitschrift*, describe an improvement in Exner's electroscope rendering the reading of the deflections more accurate. To one of the glass sides of the instrument a mirror

is attached which reflects a scale fixed on the outside of the case. The positions of mirror and scale are such that the image of the scale when seen through an observing lens is in the same plane as the edges of the electroscope leaves. Parallax is thus avoided, and the deflection of the leaves can be read with great accuracy. In the same issue, these authors describe a convenient form of portable dry pile, giving a pressure of 2000 volts, for use in experiments on the radio-activity of the atmosphere. The pile is made up of gold and silver plates built up in columns of 200 pairs fitted on ebonite rods, thirty sets being connected in series inside a metal case. The pile gives no current, but can maintain the potential of a conductor at – 2000 volts; it is said to keep in good order for several years if proper precautions are taken.

THE South African corals of the genus Flabellum receive attention at the hands of Mr. J. S. Gardiner in a recent issue of "Marine Investigations in South Africa" (vol. ii.). The author pays special attention to the anatomy and development of these organisms, and emphasises the importance of studying the polyp as well as the corallum if we hope to gain any real idea of their true relationships.

AN additional note by Dr. Forsyth Major on *Ocapia liebrechtsi* appears in *La Belgique Coloniale* for November 30. The author figures both the male and the female skulls, the latter of which is hornless. It is suggested, however, that in some instances female okapis may carry small horns. In conclusion, it is pointed out that as the okapis of the present day are natives of a continent where zebras and antelopes abound, so their extinct forerunners, the Palæotragi of the Pliocene, were associated in southern Europe and Asia with troops of hipparions and antelopes allied to modern Ethiopian types.

WE have received from the Smithsonian Institution three papers from the *Proceedings* of the U.S. Museum. The first, by Mr. C. B. Wilson, deals with North American parasitic copepod crustaceans of the family Argulidæ. It is the first of a series dealing with the large collection of this very remarkable group contained in the Museum, and, in addition to the description of these, will contain a bibliography of the entire assemblage. It is mentioned that the typical European *Argulus foliaceus* is the only member of the group which has hitherto been fully described. In the second paper, Miss M. Rathbun treats of Japanese stalk-eyed crustaceans, describing as new one hermit-crab and nine shrimps. In the third, Messrs. Jordan and Fowler continue their review of the fishes of Japan, treating in this instance of the berychoid group.

WE have received from the publisher (Herr G. Fischer, of Jena) a copy of the second, and popular, edition of Dr. C. Chun's "Aus den Tiefen des Weltmeeres," the original edition of which was reviewed in NATURE of March 6, 1902 (vol. lxv. p. 409). The mere fact that a second edition has been found advisable affords sufficient evidence that the work is deemed a success by the public. The present issue is, however, by no means a simple replica of its predecessor. No less than eighty-two additional illustrations have been introduced into the text, while some of the original illustrations have been replaced by better ones. Moreover, the text itself has been expanded by the introduction of additional chapters dealing with the deep-sea fauna, especial attention being devoted to the description of the eyes and light-organs of abyssal animals. The new illustrations include many of tropical landscapes and others of ethnographical subjects, while views of icebergs and of the desolate scenery of Kerguelen Island are also notable additions. The present enlarged edition forms an exceedingly handsome and attractive volume, which cannot fail to interest all lovers of travel and natural history.

THE U.S. Department of Agriculture has recently issued three pamphlets dealing with the protection of the fauna of the country and the traffic in game, skins, &c. The first of the three is an enlarged and revised edition of Dr. T. S. Palmer's summary of the legislation for the protection of birds other than those classed as game. The second is a digest of the game laws for 1902, by Messrs. Palmer and Olds, giving full information with regard to close-seasons, shipment, sale and licenses. In the third and shortest, the Secretary of the Department summarises the regulations connected with the trade in birds and game between the different States of the Union. It is satisfactory to learn that the regulations for the protection of birds of which the plumage is used for ladies' dress, &c., are now extremely stringent. "Under these statutes, birds which are in demand for millinery purposes are protected throughout the year, and sale and possession, as well as killing, are prohibited. It should be remembered that the principal centres for millinery supplies are nearly all located in States which have such laws, and the purchase of native song-birds, as well as of herons, pelicans, gulls, terns, grebes or other plume-birds, should be avoided."

IN the early days of the Hudson Bay Company, a large number of skins of birds and mammals were sent from the Kewatin territory to naturalists in Europe for description, and upon the evidence of these specimens numerous species were named. Of late years, but little attention has been paid to the natural history of this semi-Arctic tract, while most other parts of North America have been ransacked for zoological specimens. And as some of the Hudson Bay species were founded on indifferent specimens, while of others the types have either been lost or are now in too bad condition for comparison, great difficulty has been experienced in correlating the fauna of the area with that of the adjacent territories, especially Alaska. To remedy this unsatisfactory state of affairs, an expedition to collect specimens was dispatched some time ago by the U. S. Biological Survey, under the charge of Mr. E. A. Preble. The results of this expedition are now published as No. 22 of the *North American Fauna*. In this fasciculus, Mr. Preble gives a full series of notes on the mammals and birds of the area, illustrated by reproductions of a number of photographs of the scenery. Of mammals, two species and four races are described as new. Perhaps the most interesting of these is the barren-ground vole (*Microtus aphorodemus*), which is described as nearly allied to *M. drummondi*, but of larger size, with a stouter skull.

THE general report on the operations of the Survey of India during 1900–1901, prepared under the direction of the Surveyor-General in India, Col. St. G. C. Gore, has now been published. Parties were employed during the year in the determination of astronomical latitudes in the Karachi longitudinal series and also on experimental work connected with the Jäderin base line apparatus. Preparations for the commencement of the magnetic survey continued during the year, and it has been arranged to establish base stations at Bombay, Kodaikanal, Dehra Dun, Calcutta and Rangoon, at which places magnetic observatories are to be built and self-recording instruments installed. The recent introduction of electric tramways in Calcutta, and their impending construction in Bombay, have rendered it necessary to arrange for the construction of new observatories at some distance from the two cities. Four parties of observers were engaged on topographical operations in Burma, one on the Lushai Hills of Assam and one in the Kangra and Simla districts. Cadastral survey operations were conducted in Bengal, the United Provinces and in Burma. Forest surveys were carried out in Madras, Bombay, Burma, Bengal, the Central Provinces and the Punjab. The report is much more concise than in previous years, owing, doubtless, to the instructions for curtailment issued in 1899.

THE "*Knowledge* Diary and Scientific Handbook for 1903," issued from *Knowledge* office, is a compendium of scientific dates, facts and data which will be found useful to students in many departments of scientific work. In addition to a general astronomical ephemeris and a calendar of events of scientific interest for each month, the book contains six charts showing the movements of twelve of the principal planets during 1903, and twelve small charts which show the appearance of the heavens during each month. There are also many useful tables and several short articles, on practical work with the spectroscope, the observation of variable stars, systematic botany and other subjects.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 2. 4h. 37m. Transit (egress) of Jupiter's Satellite IV. (Callisto).
2–3. Epoch of Quadrantid meteoric shower (radiant 230° + 52°).
6. 4h. 33m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
10. 8h. 41m. Minimum of Algol (β Persei).
12. 19h. 20m. to 19h. 37m. Moon occults λ Geminorum (mag. 3·6).
13. 5h. 30m. Minimum of Algol (β Persei).
14. 8h. 14m. to 9h. 8m. Moon occults α Cancri (mag. 4·3).
15. Illuminated portion of the disc of Venus = 0·982, of Mars = 0·910.
17. 12h. Mercury at greatest elongation, 18° 45′ East.
20. 21h. Saturn in conjunction with the sun.
30. 10h. Venus in conjunction with Jupiter. Venus, 0° 44′ South.
30. 10h. 22m. Minimum of Algol (β Persei).

MAGNETIC STORMS AND SUN SPOTS.—In an article communicated to No. 4, vol. xvi. of the *Astrophysical Journal*, Father Cortie, S.J., discusses the probable connection between terrestrial magnetic disturbances and solar activity.

Instead of dealing with mean values over an extensive period, he has compared the times of occurrence of specific isolated phenomena which have occurred during the three years 1899–1901, inclusive, and from this comparison has arrived at the conclusion that the relation is certainly not simply one of cause and effect, but rather the relation of two effects springing from a common cause.

For example, in support of this conclusion, the writer analyses the occurrences of the first six months of the past year as follows. The only spot of any size to cross the sun's disc during this period was the one observed between March 5 and 13, yet this was unaccompanied by any striking magnetic disturbance. From March 13 to May 19, the visible disc was completely free from spots, and the faculæ observed were faint and unimportant, yet a comparatively vigorous magnetic disturbance took place on April 10.

Father Cortie concludes from his detailed analysis of the last sun-spot minimum that "It may be possible that sun spots are one of the instrumental causes of magnetic storms, though not the only one, but it is more likely that the two phenomena are correlated as two connected, though sometimes independent, effects of a common cause."

OBSERVATIONS OF THE PERSEIDS, AUGUST 10 AND 11, 1902.—In No. 100 of *Popular Astronomy*, Mr. Charles P. Olivier gives the results of the observations of this shower which were made at the Leander McCormick Observatory of the University of Virginia.

On August 10, during a watch which lasted from 9h. 26m. to 16h. 8m., 44 Perseids and 28 other meteors were seen, whilst on August 11 (13h. 38m. to 16h. 8m.) 76 Perseids and 26 other meteors were recorded. The maximum display occurred during the period 13h. 59m. to 14h. 59m. on August 11, 30 Perseids and 11 other meteors being recorded during that hour.

The colour of the brighter Perseids was generally orange, and the radiant points for the two dates were $\alpha = 39°·5$, $\delta = +56°·7$, and $\alpha = 46°·8$, $\delta = +56°·7$ respectively. The latter radiant was very accurately determined from an apparently stationary meteor which appeared directly over the sixth-magnitude star D.M. + 56°·798. The paths of about one-half of the meteors observed were plotted on two charts, reproductions of which accompany Mr. Olivier's article.

THE MOSCOW OBSERVATORY.—Vol. iv. of the second series of the "Annales de l'Observatoire Astronomique de Moscou," published under the editorship of Prof. W. Ceraski, gives all the details and results of the observations made at that observatory since the last similar publication was issued.

During this interval, important work has been done in refurnishing the observatory and providing it with new instruments, in order that it may pursue its researches on modern lines. A new Henry-Repsold refractor, having two fifteen-inch objectives, has been added to the equipment of the observatory, and one of smaller dimensions is now in course of construction. The meridian circle, which has been in use since 1855, is at present being reconstructed to suit modern requirements.

The results published include the following:—Meridian circle observations, by M. B. Modestow; calculations of occultations by the moon, observations of the Leonid showers of 1897–8–9, and observations of Mars (illustrated by drawings) during 1896 and 1897, by M. S. Blakjo; observations of occultations, by MM. Sternberg, Modestow and Blakjo; and a photometric study (illustrated by two charts) of Coma Berenices, together with a description of the useful work performed with a binocular of 15 mm. aperture, by M. Ceraski.

ELECTROCHEMICAL NOTES.

THE literature of electrochemistry and electrometallurgy is rapidly increasing in volume and importance, and busy people find an increasing difficulty in keeping themselves well informed as regards the more recent developments in these new branches of science and industry. The value of periodic subject-indexes of current literature on this subject is therefore very great, and all interested in these new sciences will hail with pleasure the appearance of a monthly sheet entitled *Elektrochemische Technik*, which contains an alphabetical subject-index of all recent articles dealing with applied electrochemistry, electrometallurgy and electrotyping.

This sheet is edited and published by Dr. F. Peters, of Berlin, and the first issue is dated October, 1902. It contains references to 107 recent articles on the subjects covered by the index, and French, German, English and American papers and journals have been searched in compiling this index. In some cases, short abstracts have been given of the articles indexed.

Our issue of May 22 contained a note upon the electric resistance furnaces patented and manufactured by Heraeus, of Hanau, Germany, and the use of such furnaces for melting-point determinations. These furnaces have latterly been reduced in cost and improved in efficiency by the substitution of platinum foil only 0·007 mm. in thickness for the wire originally used, and a recent issue of the *Zeits. f. Elektrochemie* contains some notes by Dr. Haagn—the chemist to the Hanau firm, upon the use of the tube form of the improved furnace for laboratory determinations.

The most important of these for the chemist is the application of the Heraeus furnace to organic elementary analysis, and, according to Dr. Haagn, this application has been attended with success. We suppose that, when used for this purpose, the platinum spiral encircling the glass combustion tube is cut up into several sections, each with its own current connections, so that successive portions of the tube can be heated as desired. The great advantage of such a furnace, from the chemist's point of view, will be the reduction of the heat losses by radiation and by the escaping gases, since these in the usual form of gas-combustion furnace are very great, and in summer time render organic analysis a most trying and tedious operation. Other proposed applications of the Heraeus tube furnaces are for the direct estimation of carbon in steels, and for the determination of ash in coal and coke. The maximum temperature attainable with these furnaces is 1700° C., and this limit is due to the inability to produce tubes, which will retain their form at this or higher temperatures.

The use of the electric current for heating glass furnaces does not seem a very promising application of electric power to those acquainted with the high degree of efficiency obtained in the modern regenerative gas furnace now generally employed in the glass-making industry. According to a recent issue of the *Zeit-*

schrift für Elektrochemie, however, this method of heating glass furnaces has not only been the subject of practical experiments in Germany, but two glass works are now in operation, working upon this principle. Two Cologne engineers, MM. Becker and Völker, are the patentees of the more valuable and practical electric furnaces of this type, and after numerous laboratory experiments they have been able to achieve the realisation of their ideas upon an industrial scale. The first "Electric Glass Factory" was built at Plettenberg on the Lenne, where a power station of 2000 E.H.P. was available for the supply of the requisite electric energy. The results first obtained here were not very satisfactory from the economic point of view, but improvements were introduced in the process which are considered to render it a commercial success, where cheap power is available. A new company has therefore been floated, the "Aktiengesellschaft f. Elektrokeramic," and a second electric glass works has been built at Deutsch-Matrei, where electric power can be obtained at a cost of 5 pfg. per E.H.P. hour at the terminals of the furnaces. This works was to commence manufacturing operations in the summer of this year, and further details of the results obtained will be awaited with interest.

Messrs. Foerster and Müller, who have devoted much time to the elucidation of the chemistry of the electrolytic chlorate cell, contribute to the *Zeitschrift f. Elektrochemie* of August 28 and September 4 details of an extended laboratory investigation relating to the changes which occur when hypochlorite solutions are electrolysed under various conditions. Sodium hydrate, sodium hypochlorite and sodium chloride solutions were used as electrolytes in their experiments, and the results show that chlorate was formed at the anode both by primary and secondary reactions under the conditions obtaining during their tests. The primary formation of chlorate is represented by the following equation:—

$$ClO' + 2O = ClO_3.$$

This reaction, however, demands the presence of ClO' ions with anodic free oxygen and an E.M.F. at the anode above 1·1 volts. It occurs under normal conditions only to a slight extent. Secondary chlorate formation occurs at the anode, not only in solutions containing free hypochlorous acid, but also in neutral and alkaline solutions, and may be represented by the following equation:—

$$6ClO + 3H_2O = 2HClO_3 + 4HCl + 3O.$$

The formation of chlorate by this secondary reaction is, however, most active when the conditions admit of the existence of free hypochlorous acid in the electrolyte, *i.e.* when the electrolyte is maintained in an acid condition during the electrolysis. In this connection, it is interesting to note that a recent French patent in the name of Lederlin, relates to an improvement in the usual electrolytic chlorate procedure, the improvement being the continuous addition of dilute hydrochloric acid to the electrolyte in the cell.

The use of ozonised air for the purification of drinking water is again attracting considerable attention. Some years ago, experimental trials were carried out at Paris and other places with processes of this character, but the trials appear to have been unsuccessful (probably on economic grounds), and for two or three years little has been heard of ozone in connection with the water supply of large towns. During the present year, the East London Water Company has, however, been carrying out trials at Lea Bridge with an ozone process of purification, and according to one of our electrical contemporaries, these trials have been fairly successful. Prof. van 't Hoff also gave details at this year's meeting of the German Electrochemical Society of experimental trials recently made with the Vosmaer-Lebret process in Holland, and his paper is fully reported in a recent issue of the *Zeitschrift f. Elektrochemie.* The Vosmaer-Lebret form of ozoniser differs from most of those previously invented in the absence of glass as a dielectric. The silent discharges which produce the ozone in the air passing through the apparatus take place between the walls of the metallic tubes which form its essential feature. An E.M.F. of 10,000 volts with one pole earthed is used, and no artificial cooling is employed. The chemical and bacteriological examination of the water before and after treatment with the ozonised air showed that the reduction in organic matter and in the number of colonies was equal to the best yet obtained by any other process, and Prof. van 't Hoff is of opinion that the Vosmaer-Lebret process may solve the problem of a pure-water supply for large towns and cities. Experimental trials of the process are shortly to be carried out in Rotterdam, in connection with the town water-works.

The electrolytic separation of antimony from polysulphide solutions of sodium and the metal is a difficult operation, for, owing to the separation of sulphur at the anode and its re-solution in the electrolyte, the metal deposited at the kathode has a strong tendency to enter again into solution. Izart and Thomas have recently been investigating this phenomenon, and have found that the difficulty can be overcome by using a diaphragm type of cell. Some details of their experiments are given in the *Zeits. f. Elektrochemie* of September 11. The solution of polysulphide is placed in the kathode compartment, and a solution of sodium hydrate is used in the anode compartment of the cell. The conductivity of the electrolyte can be increased by the addition of ammonium salts. On passing an electric current through such a cell, sulphur separates at the anode, but dissolves in the sodium hydrate solution with liberation of oxygen. At the kathode, antimony is deposited, and there would appear to be no limit to the thickness of the deposit which can be obtained under these conditions. The process is about to be tried upon an industrial scale at Cassagnac, in France, and the results obtained will be awaited with interest. Up to the present time, the only electrolytic process for the separation of antimony which has been worked upon a large scale is that of Siemens and Halske, but no details of the plant at Banya, in Hungary, have been published, and it is possible that the results have been less satisfactory than the patentees hoped.

A NEW JOURNAL FOR GENERAL PHYSIOLOGY.[1]

THE multiplication of journals devoted to particular aspects of the various branches of a science, although indicating the vigorous growth of the last decade, is not without its disadvantages; it tends to accentuate those subdivisions of the subject which specialisation must of necessity bring about. In this respect it is refreshing to realise that the particular periodical now under review aims rather at the consolidation than at the further separation of the different aspects of physiological knowledge. In this and in other respects it is a new departure and as such merits special recognition. This will be apparent to anyone who reads the excellent introduction with which the editor, Prof. Verworn, has prefaced the first number of the new venture and which, apart from its delightful literary style, is well worth perusal since it is more comprehensive than the majority of such utterances; it forms, indeed, in itself a noteworthy and suggestive contribution to contemporary physiological literature. Of the many different points which are dealt with in this editorial, only those can be referred to here which have a direct bearing upon the scope and conduct of the *Zeitschrift für allgemeine Physiologie.* The phrase "General Physiology" has been made familiar through Prof. Verworn's masterly treatise upon the subject, but as this very treatise appears to have given rise to some misconceptions as to the meaning of the terms, the editor now defines the position with more precision. General physiology is regarded by Prof. Verworn to be the science which deals with the objective phenomena of living things in so far as they are common to all or to large groups of organisms. It is noteworthy that the qualification indicated by the word "objective" has been introduced; the reason for this introduction appears to be the desire of the editor to make it clear that in his opinion physical and chemical changes are the only data which can be properly considered to constitute the subject-matter of physiology. His affirmation of this view is particularly salutary at the present time owing to the confusion which exists as to the relation of physiology to psychology, and the modern tendency to blur our sharpness of view in regard to the former subject by reviving the vitalistic views of the past. Prof. Verworn regards with disfavour the intrusion of such idealistic conceptions as have been made familiar by the exponents of "neovitalism," and accordingly he limits the subject-matter of general physiology. He also advocates a more exact phraseology in connection with physiological processes which have been hitherto described by a terminology belonging to psychology. The use of such terms is undoubtedly

[1] *Zeitschrift für allgemeine Physiologie.* Herausgegeben von Dr. Max Verworn. Erster Band, Erstes Heft. Pp. 128 + 28. (Jena: Gustav Fischer, 1902.) Preis Mk. 24.

extremely misleading; it is difficult, for instance, to dissociate those physiological processes which are generally described as "voluntary" from having a physiological connection with "volition," and yet with volition as such physiology itself can have no dealings. In the opinion of the writer of the present review, Prof. Verworn is to be congratulated upon the firm attitude which he has taken and upon his timely attempt to demarcate the scientific frontier of his subject.

In the editorial preface reference is also made to a misconception which appears to be rather widespread, and is fundamental as regards clear definition of the subject; this is the tendency to regard general physiology as identical with what has been called comparative physiology. The latter phrase is undoubtedly a wholesome protest against the restriction as to experimental material which pervades a large section of physiological work, and which causes generalisations to be drawn from phenomena observed only in a few vertebrates—the frog, the rabbit, cat, dog and monkey. But comparative physiology as the appropriate *vis-à-vis* for the extensive science of comparative anatomy cannot at present be said to exist at all; on the other hand, there is a considerable and rapidly accumulating mass of material for general physiology in the sense in which this phrase is used by Prof. Verworn. It is true that both studies postulate investigations carried out upon an extensive range of living material; there is, however, a very real distinction between them related to the end for which the study is undertaken. If this is directed so as to ascertain the phenomena exhibited by a particular animal as such, then it fitly forms part of comparative physiology; but if it is undertaken with the object of throwing light upon analogous phenomena existing throughout widespread groups of organisms, then it can be more appropriately described as pertaining to general physiology. In this latter case the object of study is selected because it exhibits some particular physiological process in an especially striking way or under especially modified conditions. The distinction will no doubt break down as our knowledge widens and a real comparative physiology comes into being, but at present it appears to be both sound and useful. In illustration of such practical utility the writer of this article draws attention to investigations upon the phenomena exhibited by the electrical organs of fishes; these have been undertaken by physiologists in order to throw light upon the electrical changes present in such excitable tissues as muscles, nerves, &c.; it is a mere incident that they also contribute towards our knowledge of the life-history of particular forms of fish. In this connection it is desirable to explain that the editor is particularly careful to guard against giving the impression that he attaches particular value to the study of the simplest forms of life; these are extremely suitable objects of study for particular purposes but he rightly ridicules the notion of there being any special virtue in a "Protistenphysiologie."

It will be clear from the above review that a very wide scope is given to the possible subject-matter of the new journal; it includes a wealth of material if only in investigations upon all the excitable tissues both animal and vegetable. The editor's hope is to bring together, by means of the *Zeitschrift*, widely scattered researches upon most diverse objects, which will, however, all be linked through their authors' aims and points of view; the whole assemblage will thus have a direct bearing in regard to those large problems of the existence of which every physiologist is aware.

In order to encourage the advance of physiology along these lines, Prof. Verworn announces his intention of giving the new journal an international character, partly by publishing at the end of each number reviews of such researches appearing in various existing periodicals as come within the scope of the subject, but mainly by undertaking to print communications in any one of the languages made official at the Physiological Congress held last year in Turin. There are at present very few journals in which physiological communications, whether German, French, English or Italian, can appear; a physiological *Zeitschrift* of this cosmopolitan character will prove to be a real boon, and will, if successful, bring into touch workers of different nationalities in a way which must be most beneficial for the advance of their science.

Space will not permit any extended reference to the researches contained in the first number of the new journal; it may, however, be said that as regards importance and varied interest they are excellent, and that Prof. Verworn is to be congratulated upon the subject-matter of his first volume. The communications include the following original publications:—"Zur Kenntnis der Narkose," Hans Winterstein; "Neue Versuche zur Physiologie der Befruchtung," E. von Dungern; "Ueber die Reaktion des Blutserums der Wirbeltiere und die Reaktion der lebendigen Substanz im allgemeinen," H. Friedenthal; "Inanitionserscheinungen der Zelle," H. Wallengren.

There is, further, an article by Prof. Boruttau upon the older and the more modern conceptions as to the causation of nerve conduction, and reviews of various contributions to contemporary physiological and biological literature by a number of competent reviewers. The journal is well printed, and such plates as are present in this first volume are quite satisfactory. It is to be hoped that English contributions to general physiology may appear in some of the succeeding numbers; in the meantime, Prof. Verworn has the hearty good wishes of many English physiologists for the success of his undertaking. F. G.

INTERNATIONAL CONFERENCE ON WEATHER-SHOOTING.

If anyone wishes to learn the history of the subject of the effect of gun firing on weather, he cannot do better than consult a most interesting and complete history, which has recently appeared as a publication of the Central Anstalt for Meteorology and Earth's Magnetism (year 1902, vol. xxxix., Vienna). The above-mentioned history is only one of several valuable articles contributed to this volume, all of which are connected with the same subject. In fact, the publication is an account of the international conference for experts on weather-shooting which took place in July last at Graz. It may be news to many people to learn that already three international and one Italian congresses have been held, and that anyone who was interested in the subject could have attended.

The congress in question was summoned to give, if possible, definite answers to two definite questions, namely, (1) Is weather-shooting effective or not? (2) If no final judgment can be given, what should be done in future and how should one proceed? In order to prepare those interested and about to attend the conference, three monographs were published and distributed a fortnight beforehand, bringing together the whole history of the subject up to that time; the methods, apparatus and arrangements of modern weather-shooting; and lastly, the criteria for judging the effect of weather-shooting and the application of the same to the numerous "effects" and "non-effects" as reported in previous congresses and publications. Each of these are printed in the present volume and are valuable contributions to the subject.

It would take too long to enter deeply into the details of the numerous meetings and discussions at the conference itself. It is of interest to state, however, that the distinguished director of the Vienna Central Anstalt of Meteorology and Earth's Magnetism, Herr Hofrath Prof. Dr. Pernter, was general reporter to the congress, and that at the end of the volume he sums up the conclusions of the conference. The first result, as he states, was that the effect of weather-shooting, based on expert evidence, appears not only—as the overwhelming majority of the opinions of experts showed—as doubtful, but as most doubtful and, indeed, improbable when all circumstances and different weights of opinions are considered.

The second main result, restricting ourselves only to two, was that the firing should not as yet be given up, but continued until it be proved that it has not the desired effect. It may be mentioned in conclusion that this publication is a model of what such a report should be, and those who have taken part in it are to be congratulated on the successful result of their labours.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A statement of the needs of the University has been circulated by the Vice-Chancellor among members of congregation. Applied mechanics is one of the subjects for which an additional professorship is asked. Better endowment is asked for the professorship of human anatomy, the readership in pathology, the Sibthorpian professorship of rural economy (now suspended), the chairs of geology, zoology, physics and experimental philosophy, and the curatorship of the Pitt-Rivers

Museum. A large extension of the system of readerships and lectureships is asked for in natural science, archæology and other subjects. The necessity of instituting and maintaining a laboratory for experimental research in the field of psychology is urged by several professors. The urgent needs of the University Museum, the Botanic Garden, the University Observatory and other departments of science at the present time involve a capital expenditure of about 30,000*l*. and an annual expenditure of 3050*l*.

CAMBRIDGE.—Mr. L. Doncaster and Mr. V. J. Woolley, of King's College, have been awarded Walsingham medals for their researches in biology. Mr. Doncaster wrote on hybridisation, Mr. Woolley on the effect upon a nerve of strong interrupted induced currents.

Twenty-three entrance scholarships and exhibitions in natural science have been awarded at the recent examinations held by ten colleges. For classics fifty-one awards were made, for mathematics thirty-seven, and for modern languages six.

DR. CHARLES PORTER, of the Public Health Hospital, Leith, has been appointed demonstrator in bacteriology at University College, Sheffield.

DR. G. S. PARKIN summarises in the *Times* the results of inquiry made at Oxford on behalf of the trustees of the Rhodes scholarship scheme to ascertain the conditions on which scholars will be admitted to the University and also the willingness of the individual colleges to receive the men selected. Almost all the colleges have already expressed their willingness to receive a certain number of the scholars annually. The *minimum* standard of admission to be kept in view by the trustees in making their selections is the ability to pass Responsions. Dr. Parkin adds:—"As much weighty evidence has been placed before the trustees to show that in parts of the United States, and in many of the colonies, it was felt that the bequest would be made more useful and effective if scholars were accepted for post-graduate and research work, as well as for merely under-graduate standing, the colleges were asked to state their preference in this particular. The replies were varied—some colleges inclining distinctly towards men prepared for advanced study, if within moderate age limits—while some are ready to take in scholars of both classes."

SCIENTIFIC SERIAL.

Journal of Botany, December.—The article on a new Senecio hybrid, by Mr. Burbidge and Mr. Colgan, refers to a form found at Sorrento, Ireland, which is intermediate in character between the common ragwort, *Senecio Jacobaea*, and an introduced species, *Senecio cineraria*. Besides the illustrations, which do not furnish very definite proof, the authors bring forward more convincing evidence in favour of their view.—The notes published by Mr. Spencer Moore refer to *Salvia Russellii*, two species of Barleria and a recently founded species of Amphoranthus.—Mr. C. E. Salmon records the finding of *Althaea hirsuta* near Reigate and discusses the possibility of the plant being a native or an alien.—Mr. Wheldon and Mr. A. Wilson give the localities of some mosses and hepatics which have been discovered in west Lancashire since their previous list, published in 1901.—A list of Shropshire Sphagna is compiled by Mr. W. P. Hamilton.—The revised catalogue of British Marine Algæ, with localities, compiled by Mr. Batters, is concluded in this number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11, 1902.—Abnormal Changes in some Lines in the Spectrum of Lithium. By Hugh **Ramage**, B.A., St. John's College, Cambridge. Communicated by Prof. G. D. Liveing, F.R.S.

The author has found that the wave-lengths of the lines belonging to the principal and the second subordinate series in the oxyhydrogen flame spectrum of lithium agree closely with those given by Kayser and Runge for the lines in the arc spectrum, but, excepting the orange line, there are considerable differences between the lines of the first subordinate series. Beginning with the orange line and proceeding to the others in order, the differences found were 0·07, 0·70, 0·49, 0·39 and 0·28 unit, the wave-lengths of the flame lines being the greater. In view of these differences, the author examined the arc spectrum in an arc struck in air and in another enclosed in a magnesia brick; the spectra of different parts of the outer flame and of the inner core of the arc were studied. He also examined the spark spectra with and without a Leyden jar in the secondary circuit. The conclusions are that the lines in the principal series appear to broaden and reverse normally. The lines in the second subordinate series do not reverse, but they broaden towards the less refrangible end of the spectrum and become diffuse on that side. The first line in the first subordinate series, λ 6103·84, broadens and reverses almost normally. The other lines in that series broaden more rapidly on the more refrangible side than on the other. The inner core of intense arcs, and the parts near the negative poles of weak arcs and sparks, give a broad reversed line with its centre about λ 4602·4, whilst the part near the positive poles in weak arcs, and the flame of the arc, give a sharp bright line, λ 4603·07, coincident with the lines in the spectra of the oxyhydrogen flame and uncondensed spark. The wave-lengths hitherto recorded for these diffuse lines would appear to be those of abnormal lines; the true lines are the sharp bright ones which occur, without complication, in the spectrum of lithium in the oxyhydrogen flame.

Entomological Society, December 3, 1902.—Canon Fowler, president, in the chair.—Mr. H. W. **Andrews** exhibited a male specimen of *Therioplectes lucidus*, from Chattenden, July, 1902. Colonel Yerbury took several females of this species at Nethy Bridge, N.B., in 1900, but there appears to be no record of the capture of the male. He also exhibited a male *Platychirus sticticus* and a female *Microdon devius* from Eltham and Shoreham (Kent) respectively; and three small dark examples of *Syrphus balteatus*, taken near Brockenhurst, where the form was not uncommon, in October, 1902.—Mr. M. **Burr** exhibited two species of Phyllium from Ceylon, sent by Mr. Green, *P. bioculatum*, Gray (= *erurifolium* Hann., and *scythe* Gray), which produces the flanged ova and is the commoner of the two, and *P. athanysus*, Westw., a scarce species with the less ornate ovum.—Mr. A. J. **Chitty** exhibited a box of insects, taken, between September 22 and October 7 last, from a decayed fence chiefly constructed of birch. The exhibit comprised about a hundred species, of which seventy-nine or eighty were Coleoptera. Four species of beetles mimicked the surroundings of lichen-covered bark, and one, *Acalles tribatus*, resembled buds.—Mr. R. **Adkin** exhibited a hybrid *Selenia bilunaria* × *S. tetralunaria*, together with spring and summer examples of both species for comparison. The hybrid presented some of the markings of each of its parents, the crescentic blotch at the apex of the fore-wings and the band on the hind-wings closely following *tetralunaria*, but no trace of the dark spot usually so distinct on each of the wings of that species, especially in the summer emergence, was visible, while the "second line" of the fore-wings closely followed *bilunaria*. In colour it more nearly resembled that of the summer brood of *tetralunaria*.

Geological Society, December 3, 1902.—Prof. C. Lapworth, F.R.S., president, in the chair.—On some well-sections in Suffolk, by Mr. William **Whitaker**, F.R.S. Notes of thirty-one new wells have accumulated since 1895, some of them giving results which could not have been expected. A trial-boring for the Woodbridge Waterworks Company gave a depth of 133¾ feet down to Eocene beds, and a thickness of Crag about double of any before observed in the neighbourhood. The author is not satisfied with any of the explanations which have been suggested. Two borings at Lowestoft show that Crag extends to a depth of 240 feet in one case and more than 200 feet in another, confirming estimates of Mr. Harmer and Mr. Clement Reid. In one of these, Chalk was reached at 475 feet. Three other wells in the neighbourhood confirm the great depth of the newer Tertiary strata. Sections are also given from the following places:—Boulge, Hitcham Street, Ipswich (corroborating the evidence for a deep channel filled with Drift given by the section at St. Peter's Quay, New Mill), Shotley, Stansfield and Brettenham Park. The last shows the greatest thickness of Drift recorded in the county, namely, 312 feet.—The cellular magnesian

limestone of Durham, by Mr. George **Abbott**. The Permian Limestone covers about $1\frac{1}{4}$ square miles near Sunderland; it alternates with beds of marl containing concretionary limestone-balls, and attains a thickness of 65 feet or so. The cellular limestones frequently contain more than 97 per cent. of calcium carbonate. Magnesium carbonate occupies the interspaces or "cells" of this limestone, and also the spaces between the balls. The patterns met with in it can be arranged into two chief classes, conveniently termed honeycomb and coralloid, each with two varieties; both classes have begun with either parallel or divergent systems of rods. The second stage is the development of nodes at regular distances on neighbouring rods, and these in the third stage, by lateral growth, become bands. Finally, in the fourth stage the interspaces become filled up. The upper beds are usually the most nearly solid. In the coralloid class, the nodes and bands are smaller and more numerous than in the honeycomb class. In both classes, tubes are frequently formed. The rods have generally grown downwards, but upward and lateral growth is common.

Anthropological Institute, December 9, 1902.—Dr. A. C. Haddon, F.R.S., in the chair.—Mr. C. **Lumholtz**, of the American Museum of Natural History, read a paper on the symbolism in art of the Huichol Indians of Mexico.—Messrs. Nelson **Annandale** and H. C. **Robinson** read a paper on some results of an expedition to the Malay Peninsula. The paper described the districts which were visited by the authors, the investigations undertaken and the material obtained. I. The *civilised tribes* are as follow:—(1) *Malays and Siamese of the district between Singora and Jambu.* Physical differences between the two are slight or absent; there is evidence of an admixture of aboriginal blood, though the aborigines are now practically extinct in the district. Two distinct physical types are to be recognised, but neither can be associated with one people or the other. Mohammedan and Buddhist customs were noted. The amusements, opium-smoking, diseases and modes of burial were described. (2) The *South Perak Malays* are distinct from the people of Patani, their standards of civilisation more occidental, but their race is non-persistent, being swamped by immigration. (3) In *Selangor* there is no long-established Malay population. (4) The *Samsams of Trang* are identical with or nearly related to the Malays of Upper Perak, but certain physical differences from the Malays of South Perak were noted, and their language, religion and weapons were described. II. The *savage tribes* are the following:—(5) *Semangs.* Their distribution, social status, physical characters and mode of life were described. (6) *Sakais.* Their distribution and relationship to Semangs were noted, and their mode of life, external relations and burial customs. (7) *Orang Laut Kappir of Trang.* Their possible relationships were discussed, with their dialect, religion and customs.

CAMBRIDGE.

Philosophical Society, November 24, 1902.—Dr. Baker, president, in the chair.—The origin of the thoroughbred horse, by Prof. **Ridgeway** (see p. 187).—Note on the resolution of compound characters by cross-breeding, by Mr. W. **Bateson**. In this note, the case of resolution of character recorded by de Vries ("Mutationstheorie," Lief. iv. p. 196) is discussed. A red Antirrhinum crossed with a white gave hybrids which on self-fertilisation gave four forms in numbers suggesting the ratio 9 : 3 : 3 : 1. These results are treated by de Vries as phenomena of "dihybridisation," but in the present communication it is pointed out that the facts so far do not preclude an apparently simpler account.—Notes on rearing the later stages of echinoid larvæ, by Mr. L. **Doncaster**. The difficulties which workers at echinoid development have met with in rearing the larvæ were pointed out, and the methods used by MacBride and others were described. At Naples in the spring and summer of 1902, it was found possible to rear larvæ of *Strongylocentrotus lividus*, *Echinus microtuberculatus* and their hybrids beyond the metamorphosis without using either a plunger or specially large jars. The larvæ were kept in four litre jars, and supplied about five times a week with fresh sea-water taken several kilometres from the coast. The larvæ usually developed healthily and metamorphosed about thirty days after the fertilisation of the eggs. Other species, such as *Sphaerechinus granularis*, however, could not be induced to develop by these means. The hybrid urchins lived for only a few days after the metamorphosis, but those of Strongylocentrotus were kept in some cases for a month, but did not change greatly during that time. The later larvæ and young urchins of the two species mentioned resembled one another very closely.—(1) On the Galois theory of differential equations; (2) On the structure of continuous groups, by the president.—Note on spontaneous ionisation in air at different temperatures and pressures, by Mr. J. **Patterson**. The object of the experiment was to find, if possible, the cause of the so-called spontaneous ionisation in air. To measure the spontaneous ionisation at different temperatures, the air was contained in an insulated iron cylinder containing about thirteen litres, and the rate of leak was measured between the walls of the vessel and an insulated electrode. This electrode was connected to one pair of quadrants of a very delicate electrometer and the rate of leak observed. The experiments showed that from the temperature of the room (20° C.) to about 500° C. the current through the gas was constant, the air in the cylinder being at atmospheric pressure throughout the investigation. To measure the ionisation at different pressures, the same cylinder and electrode were used. The joints were made air-tight with sealing-wax and the air filtered through glass wool. The results showed that down to a pressure of about $\frac{1}{3}$ atmos. the current through the gas was independent of the pressure and that for pressure below 90 mm. of mercury the ionisation was proportional to the pressure. Using the value 6×10^{-10} for e, the charge on an ion, the number of ions produced per c.c. per sec. was about 30. The results of the experiments indicate that the "spontaneous ionisation" is really due to easily absorbed radiation from the walls of the vessel.—Note on the behaviour of a potassium amalgam kathode in a vacuum tube, by Mr. T. **Lyman**.

MANCHESTER.

Literary and Philosophical Society, December 16, 1902.—Mr. Charles Bailey, president, in the chair.—Mr. Frank **Southern** and Dr. Charles H. **Lees** exhibited some Japanese magic mirrors.—Mr. R. W. **Ellison** exhibited a series of eggs of the common guillemot (*Uria troile*), showing great variety in coloration and design of markings, eggs of various shades of green, blue, yellow, brown and red being prominent.—Mr. C. E. **Stromeyer** read a paper on the graphic computation of lenses, in which he described a simple method of computing oblique rays of light which do not cross the optic axis of a lens system.—Mr. A. **Adamson** read a paper on a simple form of vernier microscope. The apparatus is specially devised to suit the elementary student in a physical laboratory who is familiar with the use of the vernier and who wishes to calibrate or determine the bore of a glass tube by measuring the length of a mercury thread within it.

PARIS.

Academy of Sciences, December 22, 1902.—M. Bouquet de la Grye in the chair.—The **president** delivered his annual address.—The prizes offered for the year 1902 were awarded as follows:—In geometry, the subject proposed for the Grand Prize was to improve in an important point the application of the theory of continuous groups to the theory of partial differential equations, the memoir crowned being that of M. Ernest Vessiot, M. Jean le Roux receiving a very honourable mention; the Bordin Prize is not awarded, M. de Tannenberg receiving an honourable mention for perfecting the theory of surfaces applicable to the paraboloid of revolution; the Francœur Prize is awarded to M. Emile Lemoine for the whole of his works on geometry, and the Poncelet Prize to M. Maurice d'Ocagne for his works on nomography. In mechanics, the Extraordinary Prize of 6000 francs is divided between M. Romazotti and M. Driencourt, M. Hartmann receiving a Montyon Prize, for his experiments on the production of the lines of slipping on the surface of elastic bodies due to their deformation, and M. Renard the Plumey Prize, for the whole of his works. In astronomy, the Pierre Guzman Prize is not awarded, the Lalande Prize falling to M. Trépied, the Valz Prize to M. Hartivig, the Damoiseau Prize to M. Gaillot, for his study of the theory of the motion of Saturn, the Janssen gold medal to M. le Comte Aymar de la Baume-Pluvinel, an encouragement and a Janssen medal being accorded to M. Jean Binot. In geography and navigation, the Binoux Prize is divided between MM. Claude, Marcel Monnier and Delpeuch. In physics, the Hébert Prize is awarded to M. C. F. Guilbert, for his work

entitled "Les générateurs d'électricité à l'Exposition de 1900." In statistics, the Montyon Prize is divided equally between M. F. Bordas, for a statistical study of the mortality in infants due to gastro-enteritis, and M. H. Duchaussoy, for a memoir on the meteorological observations of Victor and Camille Chandon de Montdidier, exceptionally honourable mentions being accorded to M. Liétard, for his work on the population of the Vosges, M. Paul Dislère, for his memoir on colonisation, and M. Peyroux, for a study of the causes of the depopulation of Elbeuf, mentions being accorded to M. R. Leroy, for a contribution to the study of alcoholism in Normandy, M. L. Mayet, for memoirs on the distribution of goitre in France and statistics of alcoholism, and to MM. Passerat and Trousseau. In chemistry, M. Rosenstiehl receives the Jecker Prize, for the whole of his works, especially those bearing on organic chemistry. In mineralogy and geology, M. de Grossouvre receives the Fontannes Prize, for his work in the field of palæontology. In physical geography, the Gay Prize is awarded to M. Berthaut, for his historical studies on the cartography of France. In botany, Mr. Roland Thaxter receives the Desmazières Prize, for his studies on the parasitic fungi of American insects, and M. Vuillemin the Montagne Prize, for his memoirs on the morphology and biology of fungi. In anatomy and zoology, the Savigny and Vaillant Prizes are not awarded, the Thore Prize falling to M. R. de Sinéty. In medicine and surgery, Montyon Prizes are accorded to M. J. Dejerine, for his memoir on the semiology of the nervous system, to M. G. H. Roger, for his work on infectious diseases, and to M. P. Ravaut, for a memoir on the cytodiagnosis of pleurisy, MM. Commenge, Comby and Guillemonat receiving mentions, and MM. E. Bodin, V. Griffon, E. Fournier, C. Guérin and Cassaët citations. The Barbier Prize is divided between M. Grimbert, for his work in chemical biology, bacteriology and hygiene, and M. Le Dentri, for a clinical statistical study of cancer of the breast. M. Ed. Imbeaux receives the arrears of the Bréant Prize, M. G. Loisel the Godard Prize, for his notes and memoirs relating to the histogenesis and physiology of the male sexual elements in birds, M. Pierre Lereboullet the Bellion Prize, for his work on cirrhosis of the liver, M. A. Clerc the Mege Prize, for a study of some soluble ferments in blood serum, and M. Triaire the Baron Larrey Prize, for his biography of D. Larrey, a very honourable mention being accorded to M. Romary, the Lallemand Prize being divided between Mlle. Pompilian and M. Hauser. In physiology, the Montyon Prize in experimental physiology is not awarded, M. Pierre Bonnier receiving the Philipeaux Prize, for memoirs on orientation and sense of altitude, M. Paul Marchal the Serres Prize, for his researches on the development of the parasitic Hymenoptera, M. J. Tissot the Pourat Prize, for a comparative study of the mechanism of respiration in mammals, and M. H. Blondel de Joigny the Martin-Damourette Prize, for his work on the pathogeny and prophylaxis of myopia. Of the General Prizes, the Lavoisier medal is awarded to M. Stanislas Cannizzaro. In accordance with the decision of the Academy to award a certain number of Berthelot medals to those obtaining prizes in the sections of chemistry and physics, MM. Rosenstiehl, Minet, Clerc, Imbeaux, Bordas, Dislère, Peyroux, Grimbert, Grignard, Fosse and Marquis, and Mme. Curie receive Berthelot medals. The Montyon Prize (unhealthy trades) is awarded to M. Claude Boucher, for a report on the methods for the mechanical manufacture of bottles, the Wilde Prize to M. Schulof, for his work on comets and shooting stars, the Tchihatchef Prize to Dr. Sven Hedin, for his scientific explorations in Central Asia, the Delalande-Guérineau Prize to M. Gonnessiat, for his work in connection with the geodetic expedition to the equator, the Jérome Ponti Prize to M. André Tournouër, for his explorations in Patagonia, the Houllevigue Prize to M. Teisserenc de Bort, for his researches on the state of the atmosphere at high altitudes, the Gegner Prize to Mme. Curie, for her work on radio-active bodies, and the Trémont Prize to M. Frémont, the Saintour Prize being divided between M. Riquier, for his work on the integration of partial differential equations, and M. Adolphe Minet, for his researches on the electrolytic production of aluminium, and the Cahours Prize between MM. Fosse, Grignard and Marquis. The prize founded by Mme. la Marquise de Laplace is given to M. Aubrun, that founded by M. Félix Rivot being divided between MM. Aubrun, Niewenglowski, Barrillon and Bénézit.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 1.

RÖNTGEN SOCIETY, at 8.30.—X-Ray Work in Private Practice: Dr. G. M. Lowe.

MONDAY, JANUARY 5.

VICTORIA INSTITUTE, at 4.30.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Landscapes in the Volcanic Districts of France: Dr. A. J. Herbertson.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Note on the Fluorescence of Naphthalic Anhydride: Dr. J. T. Hewitt.—The Saponification of Fats and Oils by means of Dilute Acids: Dr. J. Lewkowitsch.

WEDNESDAY, JANUARY 7.

GEOLOGICAL SOCIETY, at 8.—On the Discovery of an Ossiferous Cavern of Pliocene Age at Doveholes (Buxton), Derbyshire: Prof. W. Boyd Dawkins, F.R.S.

THURSDAY, JANUARY 8.

MATHEMATICAL SOCIETY, at 5.30.—A Method of representing Imaginary Points by Real Points in a Plane: Prof. A. Lodge.—On the Mathematical Expression of the Principle of Huygens: Dr. J. Larmor.—Generational Relations for the Abstract Group simply Isomorphic with the Linear Fractional Group in the Galois Field [2^n]: Prof. L. E. Dickson.—Series connected with the Enumeration of Partitions (second paper): Rev. F. H. Jackson.—On the Jacobian of Two Binary Quantics considered Geometrically: Prof. W. S. Burnside.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes of Recent Electrical Design: W. B. Esson.—Notes on the Manufacture of Large Dynamos and Alternators: E. K. Scott.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

GEOGRAPHICAL ASSOCIATION, at 3.30.—The Australian Commonwealth: Sir John A. Cockburn.

TUESDAY, JANUARY 13.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Automobiles: H. F. Joel.

FRIDAY, JANUARY 16.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Measurement of Water: Prof. W. C. Unwin, F.R.S.

CONTENTS.

THURSDAY, JANUARY 8, 1903.

FIRE PREVENTION.

Facts on Fire Prevention. Edited by Edwin O. Sachs. 2 Vols. Vol. i., pp. xxviii + 219; vol. ii., pp. vi + 226. (London: Batsford, 1902.)

THERE is so much solid matter in these works and such an amount of detail beyond the scope of an ordinary review that at first sight it seems difficult to summarise the whole; but an effort may be made to bring out the essential points sufficiently to indicate the general purport of the important subject dealt with in the 445 pages and the numerous illustrations contained in the two volumes under notice.

The principle adopted by the British Fire Prevention Committee is to give actual results of a number of practical investigations into materials and systems of construction, without commenting on or recommending any individual material or method, leaving entirely to those interested in buildings to judge for themselves as to how far such materials or methods accord with their individual requirements or specific works.

Of this principle as here enunciated almost in the Committee's own words, entire approval may be accorded; but when they go on to add that the adoption of remedies for existing defects can only be attained by the aid of legislation, meaning, of course, additional legislation, a totally new subject comes under consideration, on which it is necessary to join issue.

A careful study of the existing building laws, at least in London, goes to show that what is wanted is not so much new legislation as the faithful, firm, honourable and scrupulous execution of the present laws.

In short, it comes to this. The laws have been carefully thought out and, though not perfect, are quite sufficiently clear to justify responsible public bodies in carrying them out with strictness; but the responsible bodies are timid, not to say cowardly or worse, and the result is that everyone who chooses to fly in the face of the legal ordinances obtains some sympathetic approval from the general public and, what is much more unfortunate, occasional specific support from certain members of the public body charged with the duty of carrying out the orders of the legislature.

One of the most extraordinary and discreditable characteristics of our time is that every public body from the highest to the lowest now seems to contain a few members whose boast it is to oppose in every possible way the known intentions of the legislature, even in the special matters which the legislature has delegated to their charge.

This may seem to be a digression from the subject, but a brief explanation may be offered.

In America, the building laws are absolutely perfect. Even the Code Napoléon, the most complete of all, and, in fact, the model of all, was not more perfect, if there can be degrees in perfection, and yet in America, with an expenditure on fire appliances unparalleled elsewhere, the losses by fire are so heavy as to bring fire-insurance companies almost to despair and outlying communities occasionally to ruin.

It is not too much to hope that the time is coming when we can look with confidence and satisfaction to the honourable and rigid execution of our existing laws—in short, to the honesty and courage of those responsible for carrying out the duties which they have undertaken.

This is a point on which it is necessary to express a disagreement from the views of the British Fire Prevention Committee.

The Committee says that the Building Act of the Metropolis requires material revision and that opportunity should be taken to restrict change of purpose in buildings from that for which they were originally constructed; but to a thoughtful and experienced reader of the existing laws, it would appear that all such subjects have been sufficiently dealt with, and that it only requires honest and straightforward action on the part of the executive to carry out the undoubted intentions of the legislature.

This seems to be the great difficulty, the only real difficulty, at the present time, but it is very serious.

Consideration for interested individuals appears to be greater than consideration for communities, and all the weaker members of public bodies seem to lean towards concessions and immunities, although their position and sworn acceptance of duty to carry out existing laws admit of no mitigation or modification.

If ever there are found men in this country, as it may be assumed there will be in time, determined to carry out faithfully and rigidly the laws under which they are embodied, a great change will be observed; until then we must wait and hope, but we do hope with confidence.

The practical methods of testing building materials and modes of construction adopted by this Committee are most complete, and the results are consequently trustworthy.

In "Facts on Fire Prevention," it is stated that for the reduction of loss by fire two remedies are to be found—one, better building construction, the other, more efficient methods of extinguishing fires—and with the latter the present work is stated "to have nothing to do on this occasion," a wise limitation on the part of those concerned, as it is highly improbable, indeed almost impossible, that they can have had experience in the difficult business of extinguishing conflagrations.

The following tests are selected from the very large number detailed in the books:—

"*A Floor of Solid Wood Beams.*
"*Object of Test.*

"To record the effect of a smouldering fire of twenty minutes' duration at a temperature not exceeding 500° F., followed by a fierce fire of one hour gradually increasing to a temperature of 2000° F., followed suddenly by the application of a stream of water for five minutes and the consequent rapid cooling.

"The area of the floor was 100 or 10 × 10 superficial feet, and it was loaded with 20lbs. to the square foot.

"*Summary of Effect.*

"The under surface of the wood beams was charred to an average depth of two inches, but beyond this no damage was done."

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This was a very instructive test, and another making a comparison between doors of different material and construction gives some important results :—

"*A Wood Door covered with Tinned Steel Plates.*
"*An Iron-framed and Panelled Door.*
"*Object of Test.*

"To record the effect of a fierce fire of one hour gradually increasing to a temperature of 2000° F., followed suddenly by the application for five minutes of a stream of water and consequent rapid cooling.

"The door-openings were approximately 3ft. 9in. by 7ft. 3in., and the doors hung to open inwards—that is towards the fire.

"*Summary of Effect.*

"The wood door covered with tinned steel plates remained in position, but was much buckled and bulged, and the upper part gradually inclined inwards to a considerable extent, permitting the passage of flame. The first spurt of flame over the top of the door was seen after five minutes.

"The iron-framed and panelled door remained in position, but became red hot, buckled and warped considerably together with its rebated frame. The upper corner on the lock side gradually inclined inwards to a considerable extent, permitting the passage of flame. The first spurt of flame was seen after twenty minutes."

The two volumes under consideration contain the following numbers of tests, all of the same elaborate kind as the two selected for quotation, and with excellent illustrations showing the construction of the objects tested and the appearance presented after the tests :— Floors 11, ceilings 2, partitions 11, materials 1, doors 23, glazing 8, fire-curtains 3, making in all 59.

The Fire Prevention Committee intimates that

"In order to ensure the steady continuation and development of its investigations, it is absolutely necessary that it should receive every possible support from public authorities, learned societies, the professions interested, and above all from that great community of industrial firms primarily affected by fire."

It may be hoped that this kind of support will in some manner be afforded, but it has to be remembered that the kind of bodies appealed to can never be expected to move quickly and that some interference on their part would be inevitable ; so that on the whole it may be doubted whether it would have been possible for the Committee within the space of five years, which it gives as the period of its existence, to provide the large amount of information contained in these volumes, if it had been hampered with the collaboration of any external influence.

The volumes under consideration contain much valuable and trustworthy information on a subject quite unknown to the general public and only imperfectly known to many so-called experts, of whom some have taken up one branch, some another, but very few have mastered the details of all.

In conclusion, it may be stated that the volumes entitled "Facts on Fire Prevention" should prove of great assistance to all who have to deal with the preservation of life and property from fire. EMERITUS.

TWO BOOKS ON IMMERSED SHIPS.

Aërial Navigation: a Practical Handbook on the Construction of Dirigible Balloons, Aërostats, Aëroplanes and Aëromotors. By Frederick Walker, C.E. Pp. xvi + 151. (London: Crosby Lockwood and Son, 1902.) Price 7*s*. 6*d*. net.

Submarine Warfare, Past, Present and Future. By Herbert C. Fyfe. With an Introduction by Admiral the Hon. Sir Edmund Robert Fremantle, G.C.B., C.M.G., and a Chapter on the Probable Future of Submarine Boat Construction by Sir Edward J. Reed, M.P. Pp. xxviii + 332. (London: Grant Richards, 1902.) Price 7*s*. 6*d*. net.

THE problems dealt with in these two books have a certain similarity in that in each case the ship, or to use a more general term, the machine or contrivance, has to navigate wholely immersed in the medium for which it is designed, and this similarity is not disturbed by the condition that the submersible may have also to navigate on the upper surface of the sea, for the balloon, and especially the flying machine, equally has to start and to finish at the lower surface of the atmosphere.

There is also a similarity in the two books. The price of each is the same, to wit 7*s*. 6*d*. Here the similarity ends. It would be difficult to find accidentally thrown together two works which might have so much in common, but which make so violent a contrast.

The aërial book is disappointing, to say the least. A large part is taken up with descriptions and illustrations of the schemes of the hopeless crank. These are described as seriously as the few attempts which have been made by engineers and others on sounder lines, and the reader is left without guidance as to how much is worthy of sober consideration. An appearance of precision is imparted by the introduction of a large number of formulæ and of tables calculated from them the accuracy of which it does not seem necessary to examine. It is a little remarkable that with such an extended title the author should not have thought the names of Lilienthal and of Pilcher worth mentioning. The dreariness of this practical handbook is slightly relieved by some diagrams of the machine of Santos Dumont and by quite a nice frontispiece showing the rounding of the Eiffel Tower.

In his "Submarine Warfare," Mr. Fyfe has in effect collected and produced a series of essays, partly historical, partly mechanical and partly of more general interest, on the submarine from different points of view. This is not a text-book in any sense of the term, but a work which anyone of wide interests will read with pleasure. It is not necessary to begin at the beginning and read solidly through lest anything should be lost which would make subsequent chapters unintelligible. The reader may pick and choose first whichever chapter most takes his fancy. The illustrations are numerous and excellent.

There has been considerable doubt in this country whether the submarine will be found a valuable weapon in war, *i.e.* valuable to those who use it, or whether when the time comes to put it to serious trial it will be found more dangerous to the crew than to the ships which it is attacking. It is certain that until very recently this was

a very general opinion here, even though we knew that in France especially the development of the submarine and submersible was being very seriously pursued, and that the trials excited the enthusiasm of the public.

Now, however, that we know that our Government is quietly making its own experiments with submersibles built in this country, and that we have an introduction and a chapter in the book under review written by men of such repute as Sir Edmund Fremantle and Sir Edward Reed, in which the writers show that they are fully alive to the progress and to the great possibilities as well as to the present limitations of this new weapon, we can no longer affect to despise the armed and diving boat, but must at least prove, using the best skill we possess, what is possible both in the way of offence by and of defence against so terrible a weapon. Sir Edward Reed, after referring to the difference in density of the two media water and air, goes on as follows :—

"But it is in the face of this initial and enormous difficulty that the aëronauts of to-day have apparently persuaded themselves that they can successfully float their balloon-ship in mid-air and propel it, not only against the rapid tides of the air in which it floats, but also drive it at a good additional speed. When men are to be found capable of committing their fortunes, and even their lives, to navigation of this kind, it is not surprising to find that the far easier problem of navigating the seas beneath the surface has won the attention and the effort of enterprising men. They certainly have chosen, if the humbler, also the more promising and practical field of operation. I doubt not that they have likewise chosen the more fruitful field."

Passing over a long but interesting chapter on the morality of submarine warfare, we come to one on the mechanism of the submarine which perhaps more than any deals with the numerous scientific problems that arise. One of the troubles of the immersed ship which is not felt on the surface is the terrible effect of a small change in the position of the centre of gravity. For instance :—

"The Nordenfelt boats were certainly not successful in discharging torpedoes, for as a general rule they as nearly as possible stood up vertically on their tails and proceeded to plunge to the bottom stern first on these occasions."

By allowing the torpedo tube to fill with water immediately after the discharge, this difficulty is reduced, but it is almost wholly removed by the invention of Mr. Drzewiecki, who has contrived a clamp to hold a torpedo securely outside the boat, by which it can be turned in any direction from the inside and then be liberated by the pressure of the moving water. As the torpedo has a density nearly that of water, its liberation does not affect the stability of the ship. It has been tried with success at Cherbourg.

Even though the mechanical problems are perfectly solved of the different stabilities, of propulsion, of air maintenance, of torpedo discharge and of rising and of plunging, but not below the fatal depth, there remains the horrible fact that under water a ship is blind. When at the surface or awash, the bearings of the enemy may be taken from the cupola, and after plunging, the compass or the gyroscope alone remain to give the sense of direction ; but a compass is not at its best in such a position. Various optical tubes and telescopic periscopes are used to get some sort of view when the ship is not far from the surface, but to what extent successfully it is difficult to discover. At any rate, it is satisfactory to know that in this country the problem has been attacked by so able an optical engineer as Sir Howard Grubb.

One of the most disturbing chapters is that on the antidote to submarines. Information as to what has been done quietly in this country as elsewhere is, of course, difficult to obtain, but even though a charge of high explosion fired in the water may damage or destroy a submarine that is near enough, it is impossible to feel that there is any reasonably sure method of defence against this insidious weapon, always on the supposition, of course, that the mechanical and optical problems referred to are solved in even a fairly satisfactory way.

C. V. B.

WOLLEY'S COLLECTION OF BIRDS' EGGS.

Ootheca Wolleyana. An Illustrated Catalogue of the Collection of Birds' Eggs formed by the late John Wolley, jun., M.A., F.Z.S. Edited from the Original Notes by Alfred Newton. Part ii., Picariæ—Passeres. (London : R. H. Porter, 1902.)

TO European oologists, the name of John Wolley is both well known and held in great esteem, for not only was he one of our soundest and best ornithologists, especially in the field, but also was one of the first egg collectors who fully realised the extreme importance of securing the identification of the parent bird, of carefully, and if possible indelibly, marking each egg when taken, so as to avoid all risk of error, and of procuring and noting down the fullest possible information respecting each clutch, as well as of collecting a series of specimens to show all the variety of colour, size and shape to which eggs of the same species are subject. Collectors will therefore gladly welcome the present part, which completes the first volume of the "Ootheca Wolleyana."

The first part was published so far back as 1864, but the present part, completing the volume, has been retarded from various causes, though this somewhat long delay cannot be regretted when one realises, from a perusal of the work, how carefully the editor has brought the work up to date.

Wolley commenced the study of natural history at a very early age, and after occupying himself with botany, entomology and the habits of animals generally, he gradually began to pay special attention to oology, until after a trip to Spain in 1845 and a visit to Morocco, where he discovered M. Favier, who afterwards became so well known to ornithologists, he devoted himself chiefly to that branch of science. After his return to England, he several times visited Scotland in order to study birds in the field, especially the rarer species at their breeding places. In 1850, he made an excursion to the Faroes, which had never before been visited by any English naturalist, communicating an account of the ornithology to the British Association. In 1853, he began the work with which his name will always be associated, the investigation of the ornithology of Lapland, of which no

connected account had been published for nearly a century. Guided by geographical considerations, he fixed his headquarters on the banks of the great Muonio River, nearly half-way between the head of the Gulf of Bothnia and the Arctic Ocean, at a little Swedish farm opposite to the Finnish village of Muonioniska, and at once began to explore the country in every direction. These explorations he carried on personally for five summers and three winters, extending them to the Norwegian provinces of Nordland and Finmark, as well as to the western portion of Russian Lapland, not omitting the great lake Enara, which he found to be singularly destitute of bird-life. In all this work, he was greatly aided by a young lad, Ludwig Knoblock, with whom he fortunately fell in immediately on his arrival in the country, and finding him to possess a strong taste for observing natural objects, generally intelligent and, above all, truthful, he took him into his service and by training made him the valuable assistant he proved to be. To his perseverance, naturalists owe the solution, in 1856, of the mystery which had hitherto surrounded the nidification of the Waxwing (*Ampelis garrulus*), sought for as it had been by many travellers and in many countries. Wolley himself was never so fortunate as to see this bird, but the success which rewarded his exertions to obtain the eggs of many until then unknown or little known species can best be realised by those who are well acquainted with the last edition of Hewitson's work on the "Eggs of British Birds," in which so many of the rarities were figured. Wolley took copious notes respecting the various eggs obtained by him or his collectors, which have been most carefully reproduced in the present work, and will be of the greatest interest and use to both cabinet and field naturalists.

In 1858, Wolley, who for years had been carefully studying what was known of the history of the Great Auk (*Alca impennis*), undertook a voyage to Iceland, in company with Prof. Newton, for the purpose of making further investigations. It was assumed that this species was extinct, though no one knew that such was the case or how it had become so. Much information respecting its latter years were obtained, and it was ascertained that the last two living examples were procured at Eldey, on the south-west coast of Iceland, in 1844.

The year following this expedition, Wolley's health began to decline, and his death occurred in 1859 at the early age of thirty-six.

His valuable egg collection passed into the possession of Prof. Newton, who retaining in his service some of Wolley's collectors, has added considerably to it, hence many species are included in the present catalogue which were unknown to Wolley.

Amongst the additional notes from the pen of the editor may be especially noticed those on the nidification of the Nutcracker. Four coloured plates of ninety-seven specimens of eggs are given, which, though excellent reproductions of the various eggs and well illustrating the variation in shape, colour and markings, were, as stated in the introduction, executed some time ago. Four lithographic plates of landscapes also accompany the work, two of which are scenes in Lapland, the third being a view of Eldey, the last home of the Great Auk or Garefowl, and the fourth a view of the Alkenhorn in Spitsbergen.

Last, but not least, is an excellent memoir of Wolley, with a very good portrait of him and one of his head assistant, Ludwig Matthias Knoblock, the perusal of which will give infinite pleasure to many an oologist.

THE WANDERINGS OF A NATURALIST IN SOUTH AMERICA.

The Great Mountains and Forests of South America. By Paul Fountain. Pp. 298. (London: Longmans, Green and Co., 1902.) Price 10*s.* 6*d.* net.

IT was only a few months ago that we reviewed a book by the same author on "The Great Deserts and Forests of North America." We learn from the introduction to the present volume that it was originally intended to form a second part of that work, but, on the advice of the publishers, it was "amplified" to make a separate book. Unfortunately, the process of expansion does not appear to have been very happily carried out. In several cases, statements are repeated almost in the same words, and the volume is eked out by a quantity of miscellaneous matter that has little relation to the rest of the book. But the love of nature and the keen observation of animal life that procured so warm a welcome for Mr. Fountain's description of the deserts of the United States are not wanting when the scene is changed to the great forests of the south.

It was in 1884 that the author left behind him the region with which he has made us familiar and set out on his travels in the southern continent. It is a misfortune that he has allowed so long a time to elapse before giving his experiences to the world. It was inevitable that after the passage of nearly twenty years regrettable inaccuracies should find their way into his pages, and these seriously diminish the value of the book.

Taking Obydos on the Amazon as his base, he ascended the Rio Trombetas and subsequently the Rio Purus and several of its tributaries in a boat he had purchased in Pará, transferring himself to a bark canoe of his own manufacture when the water was too shallow for the larger vessel. After his return to Obydos, we lose sight of him for a time and then find him making his way through the forest of the upper Xingu valley to Diamantino in Matto Grosso, where he again passes out of view to reappear sporadically in Guiana, Ecuador, Colombia, Peru, Bolivia and Chili, and finally take leave of us at Rio de Janeiro.

The author is at his best in the description of his excursions up the smaller tributaries of the Purus in the twilight of the overarching trees. It was there, especially, that he was able to make a close acquaintance with the "jungle folk" of the Amazonian plain, of whom those who travel by only the more frequented ways know but little. His long experience as hunter and collector stood him in good stead, and the variety of the forms of life that he met with will seem marvellous to many who have passed over much of the same ground. He does not pretend, however, to scientific accuracy in the determination of species of animals; it is in the

careful watching of the details of their lives in their natural surroundings that the value of his work consists.

Mr. Fountain arrives at times at strange conclusions, especially with regard to the adaptation of form and colour to purposes of concealment.

"All my experience," he says (p. 78), "tends to show that coloration is at best but a partial protection. It is none whatever to the human eye, and most naturalists incline to the opinion that animals are quicker sighted than men. An inexperienced person may be deceived, the practised hunter never, unless as the result of his carelessness." "Nature's idea is to create a pleasing and curious variety to gratify the eye of man, nothing more" (p. 135).

But his own pages rebuke him. We are told (pp. 124–5) that ant-bears and sloths

"look, even when you are close to them, so much like a bundle of the dried herbage that they often escape the eye of the hunter and would be sure to do that of the novice."

In another place (p. 137), we read that the ant-bear has a habit of turning its large, bushy tail

"over its back in such a manner that when the animal is squatting on the ground, it is completely hid under it and looks like a tuft of dead grass."

And again (p. 165),

"both the two-toed and three-toed sloth . . . so much resemble a cluster of dead, dried-up twigs in the trees that they are not easily discovered except by experienced eyes."

About six days' journey north of Pernatingas, near Diamantino in Matto Grosso, some caves were discovered which would seem to deserve careful examination. The author found the "entire carcass" of an animal in a mass of stalagmite. He attempted to get it out, but it broke in pieces. It was, he states, a species of guanaco of much larger size than any now living. This is, we believe, the first time that the remains of an animal of the llama group have been reported from Matto Grosso, or, indeed, from Brazil. There were also bones that seemed "to have belonged to gigantic jaguars and deer, and many small animals and bats." He conjectures that another animal was

"of the rhinoceros kind, but if so it was of a hornless species. The bones of tapirs were here in great mass, but of species half as big again as the living kind."

We can scarcely expect the discovery of a South American rhinoceros to be verified, but the list forms an appetising menu for an osteologist.

The author's geology must not be taken too seriously, as a reference to an "extensive formation" of "fused quartz" is sufficient to demonstrate; but it is interesting to note that in a valley in Ecuador he met with "a mass of pure native iron half embedded in the ground"—apparently a meteorite. It weighed five or six hundred-weight and was "in no way oxidised by exposure to the weather." He found a similar mass "on a plain of moderate elevation, as nearly as it is possible to conjecture in the very centre of the southern continent"—a rather vague locality.

Students of the early history of the South American races will be interested in Mr. Fountain's description of a group of huts formed of large slabs of stone on the shore of a lake near the upper Purus. They are not used by the tribes now inhabiting the country, and were, he believes, constructed by a civilised or semi-civilised people since exterminated.

The illustrations appear to have been drawn to the author's descriptions. Though picturesque and creditable to the artist's imagination, they cannot, of course, claim to have any value as accurate representations of natural objects.

J. W. E.

OUR BOOK SHELF.

European Fungus-Flora, Agaricaceae. By G. Massee, F.L.S. Pp. vi + 274. (London: Duckworth and Co., 1902.)

THIS is a condensed synopsis of the mushrooms and toadstools of this and other European countries, and will be of considerable use to expert collectors of these interesting but difficult plants.

The author, in his preface, remarks on the false impression as to the significance of the term "species" which is obtained by studying the fungi of one country only, and he points out that "the Continental species can be sandwiched in between British species."

This statement is well borne out by the contents of the book, in which the European species at present unknown as British are thus packed in between our native forms, and distinctly marked off by square brackets. The method is excellent, and the work, as a whole, well done; but, useful as the book must be to the expert in the field, we are doubtful whether these short definitions of all known species do not increase difficulties for everyone but the expert. Granted that such a work was wanted, we are strongly convinced that an even greater need at present exists for a well-written and accurate account of the relatively few common types or illustrative species, arranged so as to give clearly the principal characteristics of the genera and subdivisions, and familiarise the student with the commoner species, the species being so chosen that the student shall not have to attempt the—to him often impossible—task of discriminating between closely allied and critical forms until he has familiarised himself with the common types.

If *Stropharia siccipes*, Karst., is intermediate between *S. semiglobata*, Batsch., and *S. stercoraria*, Fr., the student is driven to wonder why the three forms are kept as separate species as here defined, and many similar puzzles will arise in the minds of those who find the "species" of Agarics resting on such characters as these short and pithy paragraphs convey. These puzzles will increase as the varieties of such species as *Pluteus cervinus*, Schaeff., and *Agaricus campestris*, L., are compared with species of the genera Hypholoma, Lactarius, Cortinarius, &c.

Excellent as the definitions are, moreover, there are points which require improvement—*e.g.* the genus Lepiota is said to have "Ring present, volva absent" on p. 2; but on turning to p. 7, we read under Lepiota, "Ring free, distinct from the volva." Such ambiguities are trivial to experts, but they are serious difficulties to others, and they could be avoided.

Some questions of termination arise on pp. 206 (bottom) and 227—*e.g.* is it *Ag. rubellus*, Gillet, or *Ag. rubella*, &c.?

In conclusion, the book is fully indexed and carefully arranged, and is well printed on paper so light that, in spite of the thickness of the volume, it can be carried into the field, and it is essentially as a field-book that it can be recommended.

An Introduction to Physiology. By William Townsend Porter, M.D. Part iv. Physiological Optics. Pp. vii + 96. (Cambridge, Mass.: The University Press, 1902.)

THE complaint is often made that the laboratory courses in practical physiology can be of little value to the student, in view of the very limited range of the experiments regarded as possible for a class, and the consequent restriction of the student's attention to one or two chapters of the science. The work before us represents a further step of the creditable effort now being made by Prof. Porter to remove this slur on the practical teaching of physiology and to show that it is possible to give the ordinary student a knowledge of physiology based on his own experience rather than on the mere statement of his teacher or text-book. In this book, comprising less than 100 pages, the student is taught in the first part to determine by experiment the main laws of the reflection and refraction of light, and the formation of the image by convex and concave mirrors, as well as the properties of lenses. In the second part, the physical knowledge so acquired is applied to the determination of the optical qualities of the eye, including the mechanism of accommodation. The last three sections deal with the use of the ophthalmoscope, and its application to the estimation of errors of refraction and other defects in the dioptric mechanisms of the eye.

It would be difficult to imagine a course of study better adapted for the purpose, viz. to give the student of medicine a knowledge which shall fit him for the investigation and diagnosis of the various morbid conditions of the eye. Too many men at present begin to learn their physiological optics only when they are brought face to face with actual cases of disease—a state of things for which the physiological teacher is partly responsible. It is probable that a course such as that laid down by Dr. Porter and extending over about twelve lessons would, if introduced into the London schools, be found to meet a want and would receive appreciation and support. We shall look forward with interest to the appearance of the other parts of this practical physiology, which are to include the special senses, the central nervous system and the whole of chemical physiology. E. H. S.

The Potash Salts; their Production, and Application to Agriculture, Industry and Horticulture. By L. A. Groth. Pp. vi + 291. (London: The Lombard Press, 1902.)

THE Triassic strata yielding potash salts occupy a vast area extending through many of the German States. The potash beds are usually at a considerable depth below the surface. The proving of their occurrence is often a matter of considerable expense and uncertainty, and the establishment of mining operations on a commercial scale may occupy several years. Germany has, however, nearly a monopoly in potash production, and both the production and prices are regulated by a syndicate; the general profitableness of the enterprise is thus guaranteed. The working of a commercial trust is well illustrated by the operations of the Potash Syndicate, one object of which is to supply German consumers with a cheap article while much higher prices are charged to foreigners.

The present book contains a great deal of interesting information as to the potash mines, the mode of working them, the composition of the salts found and the steps taken to prepare various salts for the market. There is also a section of about 100 pages devoted to the use of potash salts for manufacturing purposes, and especially to their use as manures for crops and for garden produce.

The agricultural section is disappointing. No information is given as to the large experience gained in Germany on the use of potash manures in various circumstances; the examples of field experiments quoted are all of them from trials in our own country. The examples selected are naturally those in which the application of potash salts has proved a financial success. Potash manures cannot, however, always be used with profit; on many soils they produce no paying result. Every farmer should, therefore, ascertain by actual experiment what is the effect of potash on his own fields and crops before venturing on any considerable purchase of potash manures.

Nothing is said as to the antiseptic effects of potash salts and their hindrance of the decomposition of farmyard manure. Nothing is also said as to the danger of applying them in spring as a top-dressing to a growing crop, due to the injury caused to the leaves on which the salt falls. The differences in the effects of the various potash salts are also not discussed. Notwithstanding, however, the partial character of the book, it is of real value, as it brings together a great deal of information not easily procured. The use of potash manures in agriculture may doubtless be considerably extended, but, as already stated, the deficiency of the soil in potash should in every case be proved by actual experiment before any use of it is attempted on a large scale. R. W.

Advanced Hygiene. By A. E. Ikin, B.Sc., L.C.P., and R. A. Lyster, M.B., B.Sc., D.P.H. Pp. 300. (London: W. B. Clive, 1902.) Price 3*s*. 6*d*.

THIS work, though styled "Advanced Hygiene," is only written to provide a second year's course of study of hygiene and public health for those who have mastered the contents of a similar small book by one of the authors, entitled "First Stage Hygiene."

Though the matter dealt with is of a very elementary nature, its treatment often leaves much to be desired. It is in some places incorrect and in others misleading. To give an illustration, the wash-down water-closet is said to differ from the short hopper in that "the basin and trap are in one piece," which remark embraces the whole description of a wash-down water-closet.

Many of the illustrations are concerned with sanitary apparatus and arrangements in and about houses, and most of these are badly drawn and otherwise faulty. (Two of them are actually upside-down.) Jennings's plug water-closet is described as a valve water-closet, and Buchan's trap as Buchanan's. The only water filter for domestic use which is illustrated is the Berkefeld, and of this there are no less than six illustrations—all taken from a trade catalogue.

On occasions, different views are expressed in different parts of the same work. It is stated, for instance, on p. 67, that "it seems to be proved that scarlet fever may be directly transmitted from the cow," while on p. 271 it is said that "there is *a possibility* that cows may suffer from a disease akin to scarlet fever." Further, on p. 140, one reads that "the soil *may contain a number of micro-organisms*," while on p. 220 it is (correctly) stated that "the surface soil to the depth of 3 or 4 feet *swarms with bacteria*."

The analytical notes are of little value, and in many respects they are faulty. In a statement of the particulars to be obtained in a quantitative chemical analysis of water, no mention is made of the estimation of chlorine (p. 243).

Material of Machines. By Albert W. Smith. Pp. v + 103. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 4*s*. 6*d*.

AS the life of a machine tool very largely depends upon the nature and quality of the material used in its construction, it is evident that a treatise on this important

subject will be of much use to machine-tool makers. The book under notice is well worth studying; it gives an able description of the metallurgy of iron and steel; it deals with the subject in a concise manner and contains much useful general information. The subject is approached from a scientific point of view, and this is as it should be. Special tool steels are now coming very rapidly to the front; in fact, "Mushet," so long the sheet anchor of the machine shop, is being displaced by these special steels, which only require hardening in a blast of compressed air, thus getting over the risk of cracks due to water hardening and doing infinitely more work. Machine tools have now to be designed to meet the requirements of these new tool steels, more power being required to take the heavier cuts rendered possible by their use. The volume contains much unusually accurate information, but in section 72 we read that the piston rod of a steam engine is of "mild steel"; if a forty-ton steel can be called "mild," then the reviewer is with the author; the same may be said of material for crank pins. Taken as a whole, we can recommend this book. Students of machine design should study it, and those of metallurgy will not waste their time by doing so.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Traces of Past Glacial Action in the Orange River Colony, South Africa.

THE subject of glaciation in South Africa is so interesting and important that I venture to take an early opportunity of directing the attention of geologists to the farm of Brit Koppje, situated about three miles west of Vredefort Road Station, fifty miles north of Kroonstad, in the Orange River Colony. Here, on a koppje, the surface of the rock is so very conspicuously smoothed and rounded that its appearance can hardly, I think, be attributed to the action of any agent other than ice. The general resemblance to photographs of the glaciated rocks at Prieska in Cape Colony recently shown me by Mr. A. W. Rogers, of the Cape Colony Geological Commission, is very great (see a paper read before the South African Philosophical Society by Messrs. Rogers and Schwartz on November 29, 1899).

The bedding planes of the rock are perpendicular and the strike is nearly from north to south. So far as I can recollect (although I was unable to take any accurate observations on this point), they are cut across by the slope of the rounded surfaces, which run rather in a north-easterly to south-westerly direction.

The locality can be very easily visited from Vredefort Road Station. G. E. H. BARRETT-HAMILTON.

Kilmanock House, Arthurstown, Ireland,
December 22, 1902.

Risley's "Tribes of Bengal."

HAVING had occasion to make use of Mr. H. H. Risley's valuable anthropometric data of the tribes and castes of Bengal, some of the "means" for the cephalic breadth, minimum frontal breadth and maximum bizygomatic breadth were incidentally recalculated. This was done whenever the tabulated value for the mean seemed a highly improbable one, and as some serious differences between our means and those given by Mr. Risley were found, it was thought well to point this out for the benefit of those who may be basing their arguments on these data without recalculation. Thus, in vol. i., for the Murmi tribe of the Darjiling Hills, for the mean minimum frontal breadth Mr. Risley gives 113·5, where we find 107·2; for the maximum bizygomatic breadth Mr. Risley's value is 145·9, ours is 138·4.

In vol. ii., Káchi caste of N.W. Provinces and Oudh, for the maximum bizygomatic breadth Mr. Risley's value is 120·8, ours is 130·0. Pathán caste of Panjáb, for the minimum frontal breadth Mr. Risley's value is 117·7, ours is 110·3. These are very serious differences.

As it was important to determine how far these discrepancies reflected on the general accuracy of the work, the means for six tribes taken at random were recalculated. I will merely give a list of the figures for the means:—

Risley.	Recalculation.
132·5	132·57
143·2	143·25
102·6	102·60
132·5	132·59
138·6	138·69
97·7	97·73

There is substantial agreement, except in the decimal figure.
S. M. JACOB.

Biometric Laboratory, University College, London,
December 21, 1902.

Local Floras of India.

THE writer of the notice of "The Trees, Shrubs and Woody Climbers of the Bombay Presidency," by W. A. Talbot (NATURE, December 18, 1902, p. 148), refers to the need of local floras to supplement Sir Joseph Hooker's "Flora of British India," and names several works of this nature, though not always correctly, which have already appeared. Perhaps I may be permitted to add a few facts on this subject.

In the first place, it should be known that Sir Dietrich Brandis's "Forest Flora of the North-West and Central India" is not, in any sense, an outcome of the "Flora of British India," as it was published before the first volume of the latter work. Further, the late Dr. Trimen's "Handbook of the Flora of Ceylon" was not completed by himself, the last two volumes having been prepared by Sir Joseph Hooker. Among the local floras not mentioned by the writer of the notice in question is Dr. T. Cooke's excellent "Flora of the Bombay Presidency" (see NATURE, vol. lxv., 1901, p. 88), of which two parts have been issued, containing the natural orders Ranunculaceæ to Leguminosæ. Two other important works of the same class are nearly completed, namely, "The Flora of Bengal" and "The Flora of the Gangetic Plain." The former is by Major D. Prain, the Superintendent of the Calcutta Botanic Garden and Director of the Botanical Survey of India, and the latter by Mr. J. F. Duthie, Director of the Botanical Department, Northern India. I am not sure that I have given the exact titles these two books will bear. Then there is the modest but useful "Forest Flora of the School Circle, N.W.P.," by Upendranath Kanjilal. More ambitious among the works supplementary to the "Flora of British India" are the "Annals of the Royal Botanic Garden, Calcutta," commenced by Sir George King and continued by Major Prain. Upwards of 1600 quarto plates illustrative of the flora of India have appeared in this publication, including 450 orchids. Finally, there is the second edition of Gamble's "Manual of Indian Timbers," which contains a vast deal more information than the title would imply. W. BOTTING HEMSLEY.

Herbarium, Kew.

IT was not necessary for our purpose to cite all the works dealing with the Indian flora that were published during the quarter of a century that elapsed between the issue of the first (1872) and of the last volume of Sir Joseph Hooker's "Flora of British India" (1897). In the preface to vol. vii. of that work, the "Forest Flora of the North-West and Central India," by Dr., now Sir, Dietrich Brandis, is mentioned among the works "that have appeared during the publication of the 'Flora of British India,'" and the date assigned is 1874.

The first part of Sir Joseph Hooker's "Flora" was issued in May, 1872, the second in January, 1874, the third in February, 1875; it is in this latter section, at p. 527, that we find the first citations from Dr. Brandis.

Other publications of Mr. C. B. Clarke, the late Mr. Kurz and Colonel Beddome are alluded to in Sir Joseph Hooker's preface, in addition to those cited in Mr. Hemsley's note.

The second edition of Mr. Gamble's "Manual of Indian Timbers" has only reached us quite recently, and, as we believe, since our previous note was written.

THE REVIEWER.

THE SIMILARITY OF THE SHORT-PERIOD BAROMETRIC PRESSURE VARIATIONS OVER LARGE AREAS.

In an earlier number of this Journal (vol. lxvi. p. 248, July 10, 1902), an account was given of the great similarity of curves representing many solar and meteorological phenomena,[1] and it was suggested that their close accordance indicated, not only the intimate relation between solar and meteorological changes, but the importance of the short-period (three to four years) variations common to them all. The variations of solar activity, as indicated by the greater or less number of spots or prominences or by the changes of latitude of the former, were suggested to have such an action on the atmospheric pressure on the earth's surface that when one place recorded an excess, another, nearly antipodal as regards position, showed a deficiency of pressure. Thus the regions specially referred to were those of India and that about Cordoba, in South America.

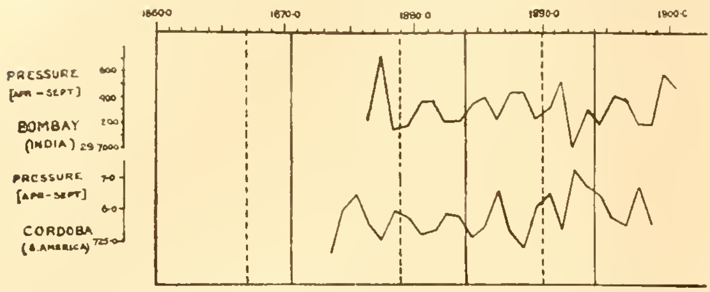


FIG. 1.—In this and all the subsequent figures, the continuous and broken vertical lines represent the epochs of sunspot maxima and minima respectively.

This reversal of conditions, extreme high pressure in one place and low pressure in another at the same moment of time, independent of the yearly or seasonal change, a fact which has since been corroborated by another investigator, as will be seen further on, can be well seen by examining two pressure curves such as those of Bombay and Cordoba (Fig. 1); in each case, the mean pressure for the same months has been used.

In the paper already referred to, it was further pointed out that just as the pressure variations of Bombay were typical of the whole of India, so were those of Oxford (England) or Valencia (Ireland) for western Europe.

With these facts in view, it was important, therefore, to investigate the extent of regions having similar pressure variations, and in the first instance to restrict the inquiry to those areas surrounding India and Cordoba. The results of such a barometric survey were communicated to the Royal Society last October,[2] and it is the purpose of the present article to state the results which have been obtained.

It may, however, first be mentioned that the monthly means of the pressure variations for each station were divided, as in the previous article, into two periods, namely, those months in which the pressures are above and those in which they are below the normal, the normal being the mean pressure for the whole period under investigation in each locality.

Thus, for instance, to take the cases of Bombay and Cordoba, the former has its high-pressure months from April to September and the latter from September to March.

It happens, therefore, in dealing with large areas, that during the same period of time (that is generally, but not invariably, six months) the pressure is above the normal in some places and below the normal in others. In interpreting the curves, therefore, it should be borne in mind that in the one case in which high-pressure months are considered, the crests of the curves denote times of increased pressure, or an excess above the normal conditions, while in the other, where the low-pressure months only are employed, the crests represent the times at which the pressure is not so low as usual.

Dealing first with the region about India, the accompanying curves (Fig. 2) illustrate the variations of pressure which have been analysed. In this set of curves, about the same months are in question, so that the pressure

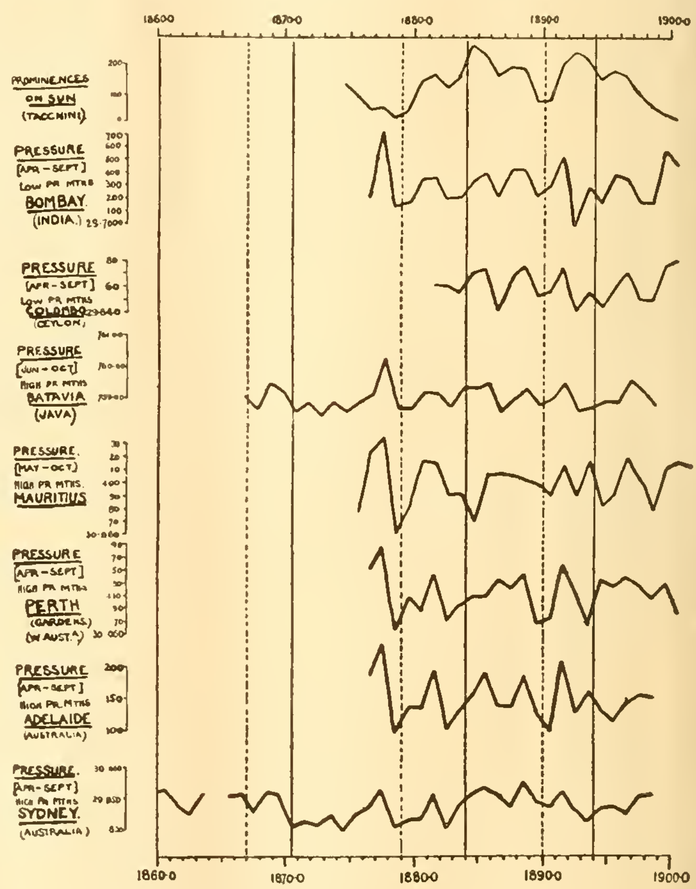


FIG. 2.

variations refer to the low-pressure (summer) months in the northern hemisphere and to the high-pressure (winter) months in the southern hemisphere.

Commencing with Indian pressures (as represented by Bombay), the area was gradually extended to Ceylon

[1] "On Some Phenomena which Suggest a Short Period of Solar and Meteorological Changes," by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Roy. Soc. *Proc.*, vol. lxx. p. 500). [Received June 14, read June 19, 1902.]

[2] "On the Similarity of the Short-Period Pressure Variation over Large Areas," by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Roy. Soc. *Proc.*, vol. lxxi.). [Received October 18, read December 4, 1902.]

(Colombo), Java (Batavia), Mauritius, and finally to Australia (Perth, Adelaide and Sydney).

The striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variations is in action, and that therefore the whole region is intimately connected meteorologically.

Attention was next paid to extending the region around Cordoba, which station, as has been previously pointed out, exhibits pressure variations similar to, but the inverse of, those of India.

As Cordoba represents an area south of the equator, and the neighbouring stations exhibit similar pressure variations, a portion of the United States of America was taken as typifying an area with north latitude and in about the same longitude, and a commencement was made along the lowest available parallel of latitude.

This was rendered possible by the kindness of Prof. Bigelow, who forwarded proof sheets of a new reduction of United States pressures which he had just completed.

Treating these pressures in the same way as those for the Indian region, several stations which had the best record were chosen. A graphical representation of the variations of four of these stations (Mobile, Alabama; Jacksonville and Pensacola, Florida; San Diego, California) is given in Fig. 3, and for the sake of comparison the pressure of Cordoba, with the *inverted* curves representing the Bombay pressure and solar prominence variation. This series of curves refers in all cases to the variations of the means of the high-pressure (winter) months (October to March in most cases). At Cordoba, which has a southern latitude, the high-pressure months extend from April to September.

The result of the comparison shows that in this region of the world we have also a large area the pressure variations over which are very similar to one another.

Although the general agreement between the two main sets of curves is most striking, there are minor differences which probably will eventually help to determine those cases in which the prominence effects on pressure are masked by some special conditions.

From these collected series of facts it will be seen that, as regards similar short-period pressure variations, the two regions about India and Cordoba have been considerably extended, and extended on both sides of the equator in each case.

With these two large areas indicating similar barometric variations from year to year, but one showing an excess while the other displayed a deficiency, new questions were at once raised. It required, however, a far more general barometric survey over other areas before such questions could be answered, but so suggestive were the facts observed that, as was stated in the paper, such an inquiry was at once undertaken and is still in progress.

It may, however, here be mentioned that already many other localities have been examined. The Indian area has been extended, for instance, to Aden and Egypt, the former of which places is practically a counterpart of India as regards these barometric variations, while the latter approximates to it. If, on the one hand, we denote land areas the barometric variations of which are very like those of India with a positive sign, and those with a positive query sign (+?) which are more like India than Cordoba; and, on the other, pressures similar to those of Cordoba with a negative sign, and those which are more like Cordoba than India with a negative query sign (−?), then it is found that, so far as barometric observations which have as yet been examined are concerned, the earth's surface may be divided approximately into two main regions, one positive the other negative, separated from one another by areas the pressure variations of which may, according to the above notation, be described as positive and negative queries (+?, −?).

It is fortunate that while this reduction and collation of barometric facts has been pursued in this country, another investigator has been working on similar lines in the United States, making it possible to compare results. In fact, Prof. Bigelow's research,[1] which was received some time after the above-mentioned was communicated to the Royal Society, has led him to very nearly

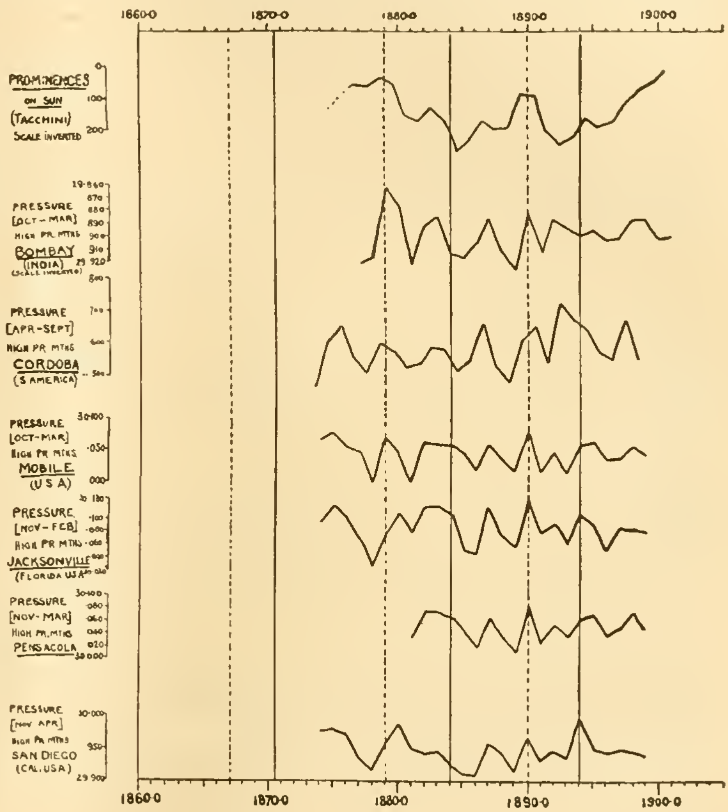


Fig. 3.

the same conclusions as those stated in the present article, if some minor differences be excluded. One of these differences arises from the fact that he has formed the mean of barometric observations made over an area including north-east China, Japan, north India, central India, south India, Batavia and Mauritius, while there seems evidence to show that the whole of India, Batavia and Mauritius behave differently from Siberia, northern China and Japan. This, however, he somewhat concedes later in his article as he points out that "in Siberia and Russia the synchronism begins to break a little . . ." Another difference will be referred to a little further on.

Apart, however, from these, Prof. Bigelow finds that "the same pressure variations, in fact, prevail over very

[1] *Monthly Weather Review*, vol. xxx. No. 7, p. 347, "Studies on the Statics and Kinematics of the Atmosphere in the United States, No. vii., A Contribution to Cosmical Meteorology" by Prof. Frank H. Bigelow (dated August 12, 1902).

large districts of the earth though varying from one region to another."

He says further :—

"If we compare the successive pressure groups with the prominence curve, it will be seen that India and south-eastern Asia are in very close synchronous agreement. This synchronism extends also to New South Wales, the Indian Ocean and even to South Africa. In Siberia and Russia, the synchronism begins to break a little and seems to be transferred somewhat towards the right, although this may be due in part to defective data. In Europe and in the United States, while the same curve is developed as to the number of the maxima and minima, the synchronism becomes more irregular. In South America, on the other hand, the synchronism is resumed very distinctly, but the *entire curve is reversed as referred to India and the Eastern Hemisphere.* Thus we perceive that around the Indian Ocean the synchronism is clearly developed ; it weakens in Europe and North America, and it becomes a distinct reversal in South America . . ."

From the above, it will be seen that Prof. Bigelow also demonstrates the existence of large areas which are in excess and in defect of pressure simultaneously, while others are not in such close synchronism.

It may here be mentioned that he treats North America as a whole and gives a curve showing the short period variation of pressure. It is of interest, however, to note, as has been shown earlier in this article, that the southern

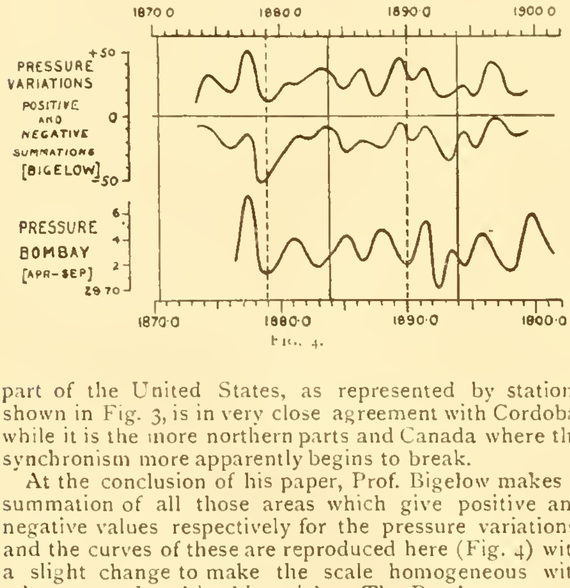


FIG. 4.

part of the United States, as represented by stations shown in Fig. 3, is in very close agreement with Cordoba, while it is the more northern parts and Canada where the synchronism more apparently begins to break.

At the conclusion of his paper, Prof. Bigelow makes a summation of all those areas which give positive and negative values respectively for the pressure variations, and the curves of these are reproduced here (Fig. 4) with a slight change to make the scale homogeneous with others reproduced in this article. The Bombay pressure curve has also been added, and a smooth curve is drawn through the points instead of connecting them with straight lines as in Fig. 2.

The parallelism of the two upper curves indicates, as Prof. Bigelow points out, that "the values do not cancel each other," and that as "the curves match fairly well with the prominence curve, . . . I take it to mean that *some external force is at work to raise and lower the total atmospheric pressure by a small amount from year to year.*"

The two investigations are in agreement as regards the following three main points. First, the close connection between solar activity and barometric pressure ; second, the great extent of areas over which very similar pressure variations exist ; and, third and last, the presence of two large areas the pressure variations over which are the reciprocal of each other.

It is interesting to remark that, from the comparisons of the pressure variations over the different areas, the authors of both these investigations were led to consider whether these suggestive features were connected with the idea of a periodical see-saw of pressure extending over a few years between these two nearly antipodal areas, or whether we were in presence of a barometric wave travelling round the earth.

There seems little doubt that when more facts are collected these reciprocal pressure variations will in time play an important part in forecasting the general features of seasons and thus supply meteorologists with another means of helping them in their difficult task.

The value that must in future be placed on observations of the sun which inform us of his state of activity or quiescence, since these pressure variations are apparently so closely connected with them, cannot any longer be laid on one side, but must be recognised as of a high order of importance. WILLIAM J. S. LOCKYER.

EDUCATION IN GERMANY AND ENGLAND.

MANY people in this country, eminent men of science and literature, leading men in commerce and industry, and politicians who place efficiency before party shibboleths, have for many years felt apprehensive as to the condition of our national system of education. For a long time, they have been speaking and writing upon the subject and endeavouring—by pointing to advancements and achievements of other nations who have put their educational house in order—to stir up the nation at large to realise the enormous interests which are at stake. For many years, the warnings fell upon deaf ears and the advocates of reform were either looked upon as bores or cranks. To-day all this is changed, and it is almost unfashionable not at least to talk about education ; this does not, however, necessarily imply a knowledge of the subject.

Were it not for its terrible prolixity, those who really desire to know the ins and outs of the German educational system could not do better than carefully study vol. ix. of "Special Reports on Educational Subjects," dealing with Germany, which is issued by the Board of Education. A mere glance at this report shows that, although the present system of education in Germany has been of such incalculable value to the Empire, yet those interested in education in that country—and their name is legion—are questioning whether their system is after all so good as it might be. There are many in Germany who think that some of our freedom from restraint would give a breadth of idea and a broadness of horizon which is not obtained by their methods of abstract reasoning and rigid exactness.

The report embraces primary, secondary and technical education. The first 200 pages consist of dissertations by different writers upon different aspects or phases of education. The first of these is by Mr. M. E. Sadler, who has compiled the report, upon "The Unrest in Secondary Education in Germany and Elsewhere." This also includes a comparison between English and German methods. Mr. Sadler admits at once that we have an insufficiency of good secondary day schools and that education at our public schools is not what it should be. Further, our technical training is defective, and, owing to our comparative neglect of national education for many years past, "as a nation we are much less intelligently interested than the Germans in methods of instruction." It is true that German and French methods are now very much advocated in this country, but the great difficulty is that those who desire us indiscriminately to imitate and introduce curricula and methods from other nations seem totally unable to realise that if we wish for an exact copy, we must at the same time reproduce the social and economic conditions of these other countries.

The old idea in England was, teach a boy to be manly, teach him not to be a sneak and a coward, and at the same time give him a smattering of education, then let him be placed in the Army or Navy or business and, come what may, character will carry him through. There is no doubt about it that our public-school life, with its traditions and the *esprit de corps* which it engenders, has had much to do with moulding character, and in past generations, when other nations were settling their internecine troubles and it was simply a question of staking out claims for posterity, this style of education was satisfactory enough. But Germany and other nations, as soon as they had settled their internal struggles, proceeded at once to build up a system of national education which has had far-reaching effects upon many of their most important industries. Not only has German education had such enormous influence upon their own industries, owing to the introduction of scientific methods, but it has likewise been felt in this country, because our manufacturers and traders, not having been taught to believe in scientific training, have stuck to old-time methods, with the disastrous result that in many branches of industry we are unable to compete with the scientific German. In Prussia, all the secondary schools are upon the same lines. The Prussian knows the meaning of a secondary school; it would puzzle an Englishman to define one. The standard is practically the same in all the Prussian secondary schools; here we have no standard at all. English masters as a rule are devoted to their schools, German masters to education. An English boy loves his school; a German boy has not the same feeling of *esprit de corps*, but looks upon his school as an establishment for obtaining knowledge. We lay stress on character, the Germans on knowledge. There are good points in each. The tendency in our schools to make the school standard one of proficiency in sport, and to make fun of earnestness and to chaff those who desire to obtain knowledge, is not good. That objectionable expression "don't talk shop," which is often hurled at the head of those who, through a sincere interest in their business or profession, wish to exchange ideas with others, is the outcome of this characteristic. On the other hand, the Germans would undoubtedly gain if they had more freedom from restraint and were not so bound down by hard and fast rules and regulations.

Other nations have realised that an education which was sufficient fifty years ago is antiquated and of little value in the present day, when science and learning have made such enormous strides. In matters of educational reform, or of accepting new views or theories, we have, as a nation, always shown a conservative spirit. When learning was only advancing slowly and new theories were propounded which had very little foundation of fact to rest upon, doubtless a conservative and cautious policy led in the long run to greater solidarity and was better than being too hasty in taking up new ideas solely because they were new, but which would almost immediately require to be discarded for some newer theory. But now, since the growth of knowledge, resting, as it does, on a broad foundation of experimental fact, is so rapid, it is absolutely essential that we should alter our methods in order to keep abreast of the times.

Fifty years ago, a boy might spend the bulk of his time upon the study of classics and yet be fitted to take his place in business or commerce. To-day, classics alone are of little use. Here it should be pointed out that in Germany the study of classics is not neglected; indeed, considerable stress is laid upon that study. Science is, as a rule, not taught until the boys have at least obtained a thorough general grounding in classics, and there are those in Germany who would make the classical education more thorough than it is at present. The following instance illustrates how thorough, in general, the study of Latin in Germany must be. An Englishman, a friend of the writer's, went to study in Bavaria and had no knowledge of the German language. A nephew of his landlady, a boy of about fifteen, was studying at a public secondary school, and although the Englishman was unable to make his landlady understand his wants, he was able by means of Latin to converse with her nephew and so have his wants attended to.

In a Prussian secondary school, a master has to know a great deal more of the subject which he has to teach than an English master in a similar position. In England, erudition is considered of far less importance than activity of mind and body and success in sport. We often say, "All work and no play makes Jack a dull boy"; we seem to forget the converse, that much play and little or no work unfits the boy for the struggle in after life. On p. 215 of the report, we find the following quotation from the remarks of a Frenchman:—"A boy at an English public school has qualities which a French schoolboy does not possess, but those qualities are moral and not intellectual. In English education there is a very weak point—and that is *instruction*." An educational system in which the weak point is instruction surely requires overhauling.

The object in our schools should be to teach that the most lasting form of pleasure is to be found in work well done. R. L. Stevenson once said, "I know what pleasure is, for I have done good work." It has been stated that one of the reasons why the Americans are so successful in the present day and seem to be carrying all before them is that "they find their pleasure in their business."

Centralisation is the backbone of the German and French educational systems. Here we have found that centralisation spells *red tape*, and now with the swing of the pendulum the cry is for decentralisation. Wholesale decentralisation will probably spell chaos. It is essential that we should have a satisfactory primary education, to be followed up by an efficient and carefully planned scheme of secondary education, but it is very doubtful whether the carrying out of even the finest imaginable system of education could be left entirely to the local authorities or to the teachers themselves. It would not be satisfactory to bind down teachers to a hard and fast interpretation of any code or system. Scope must be left for individuality, not, however, for eccentricity.

There is one thing the report makes abundantly clear, and that is that we have much to learn from the Germans; there are many things we might adapt, but very little that we could copy. There is a tremendous outcry in this country for specialisation, and many advocate early specialisation. Early specialisation is not at all believed in on the continent. In the continental university or polytechnic, specialisation is not allowed until a scholar is able to show that he has a thorough general education. We ought to have some equivalent to the German "Abiturienten," or leaving examination. Unless such an examination has been successfully passed, the student cannot enter a university or polytechnic and take his degree or diploma. Further, in obtaining situations in business houses, preference is invariably given to those who have successfully passed this examination; indeed, many business houses will not take men into their employment who have not passed this satisfactorily.

Sixty-five pages of the report are devoted to the "Measurement of Mental Fatigue." We find that the systematic study of mental fatigue has been taken up in a spirit of earnest, scientific inquiry; and it is worthy of note that post-mortem examinations have shown "that those parts of the brain which serve the purpose of systematic thought, commonly known as the reasoning powers, are the last to mature." The question of what constitutes mental fatigue must always be one of great difficulty. If the laws of hygiene are obeyed

and the subject is sufficiently clothed and fed, he will probably be able to accomplish a very much larger amount of mental work, without being over-strained, than would be the case if these conditions were neglected.

In Germany, the question of dealing with over brain work is probably more pressing than it is in this country, because the brain is often over-exercised, while there is an insufficiency of physical exercise. In England, I am afraid, it is more often a question of physical fatigue than one of mental strain with which we are faced. But of course, when the teaching system is "unintelligent"—that is, one of *cram*—the poor brain must get terribly wearied.

Mr. Sadler has compiled the report with great care, and the portions which he has himself written are marked by a refreshing breadth of view not always to be found in Government reports. It is probable, however, that the object would be better attained if these reports were more condensed. F. MOLLWO PERKIN.

TIDAL CURRENTS IN THE GULF OF ST. LAWRENCE.

FOR many years past, the Canadian Government has been prosecuting an accurate survey of the complicated tides and tidal currents of the Gulf of St. Lawrence. The Tidal Department, under the able directorship of Mr. W. Bell Dawson, has already done much excellent work in this field, although, doubtless, much yet remains to be discovered. In the tidal report for the present year, Mr. Dawson will describe the results of a careful analysis of the remarkable tidal currents which are met with in Northumberland Strait south of Prince Edward's Island. At most places, the times of the changes of tidal currents bear a more or less constant relationship to the times of high and low water, but in this channel the changes are found to be largely governed by the moon's declination. As Mr. Dawson remarks:—"This is very confusing to the mariner, as the turn of the current in relation to the tide is out of accord with the moon's phases, and has thus no fixed relation to the spring and neap tides. The greatest apparent irregularity is when the moon's declination is at its maximum; and this occurs sometimes at the spring tides and sometimes at the neaps. The ordinary navigator takes refuge in the conclusion that the currents are chiefly influenced by the wind."

Diurnal tides are ruled by the declination of the moon, and it would seem that there must be at this place a large diurnal inequality which manifests itself more by current than by variations of height.

Those who are interested in this subject will do well to refer to Mr. Dawson's forthcoming report.

G. H. D.

JOHANNES WISLICENUS.

THE generation that laid the foundation of organic chemistry has almost become a thing of the past, and at the close of last year one of the few remaining links was broken by the death of Wislicenus.

Not long since, the University of Leipzig was mourning the loss, at a venerable age, of a distinguished physicist; to-day the chair which was made famous by that "wahre Bearbeiter" Kolbe is vacant, and a name which will ever be illustrious in the history of spacial chemistry has been added to the classical traditions of this great seat of learning.

The news has come not as a sudden shock, for of late years the health of the venerable Geheimrath has been visibly declining, and waning strength and feeble gait warned his many friends that his working days would soon be over; none the less poignant, however, is the grief felt by all who have had the privilege of sharing his friendship or coming under the influence of his impressive and genial personality.

Johannes Wislicenus was born on June 24, 1835, at Klein-Eichsted, in the Prussian province of Saxony; when he was five years old, his father, a pastor, was transferred to Halle a. Salle, and there the boy received his first impressions of school life. At the "Frankesche Stiftung," a school which has since become celebrated, he remained until the age of eighteen, and at Easter, 1853, having passed his Maturitätsexamen, he entered the University of Halle with the intention of devoting himself to the study of natural science. His project was, however, soon frustrated. The political horizon was still clouded over, and in consequence of certain intrigues, his father, in the autumn of the same year, was compelled to fly the country; he found a home for himself and his family, as did so many refugees of that time, in the United States. In the following year, Johannes was appointed assistant to Prof. Horsford at Harvard University, Mass., and in 1855 became lecturer at the Mechanics' Institute, New York, with a laboratory at his disposal.

It was thus that he acquired that command of English which was such a source of wonder to his foreign students in later years.

In 1856, he was able to return to Europe, and resumed his interrupted studies at the University of Zurich, where he "promovierte" in 1860 and was appointed Privatdocent at the Polytechnic.

In 1861, he became professor of chemistry and mineralogy at the "Kantonale Industrieschule." Four years later, he received the honour of a chair at the University of Zurich, and in 1871 was elected by the "Bundesrath" as director of the Polytechnic in that town. In the following year, he was chosen to succeed Ad. Strecker at Würzburg. There he remained until 1885, and it was during this time that he carried on his classical researches on the constitution of acetoacetic ether and so established his reputation on a firm basis.

The year 1884 witnessed the death of Kolbe and the call of Wislicenus to Leipzig, where he remained until the end. As was pointed out by a writer recently in this Journal, "there is a curious irony in the thought that his first work there should have been directed towards the extension of the theory of Van 't Hoff, whom Kolbe had regarded with such contempt."

Of his scientific work, space will only permit the barest outline. His researches were confined almost exclusively to the domain of organic chemistry, most of them appearing in *Liebig's Annalen der Chemie*. The constitution of lactic acid, on which he worked from 1863 to 1872, establishing the identity of structure for the two different substances fermentation- and para-lactic acids, first brought him into prominence among chemical workers and impelled him to seek an explanation of the metamerism in the spacial relations of the atoms within the molecule. His interest in acetoacetic ether, to which reference has already been made, resulted in a detailed investigation of its reactions and of its value as a synthetic agent; these have gone far to stimulate the study of this most interesting compound, and are of importance, if for no other reason, for the light they throw on the still open question of its constitution.

It was in Leipzig, however, that he achieved his great work. In 1887 appeared his famous memoir, "Über die raümliche Anordnung der Atome in organischen Molekulen," to account for the phenomena of "geometrical isomerism." According to his hypothesis, which was an extension of that formulated independently by Le Bel and Van 't Hoff in 1874, "the centre of gravity of a carbon atom was regarded as situated in the centre of a tetrahedron, and its four affinities at the four corners." When two atoms were linked together, Van 't Hoff, and

after him Wislicenus, assumed that both were capable of rotating in opposite directions about a common axis; this possibility ceased, however, with a double or treble linking of the carbon atoms. Wislicenus further called into play the action of certain "specially directed forces the affinity-energies" which "determine the relative positions of the atoms to one another in the molecule."

The *Annalen* of these years contain a large number of papers worked out in the Leipzig laboratories under his direction, in which the reactions of maleic and fumaric acids, the tolane dichlorides and dibromides, mesaconic and citraconic acids, the crotonic acids, the α-chloropropylenes, &c., were carefully investigated, and the facts shown to be in agreement with those demanded by theory.

The hypothesis naturally evoked much criticism; Wislicenus's controversy with Fittig (*Liebig's Annalen*, 1892, cclxxii. 1–99) is still fresh in the minds of chemists, and it must be admitted that Michael has obtained results which it has not yet been found possible to reconcile with the theory. But when all is said, there can be little doubt that up to the present it remains the simplest and most comprehensive explanation adduced. Even if the theory should ever be disproved, Wislicenus's memoir will always hold a place among the classics of the science as a model of careful reasoning and literary skill, and as an epitome of one of the most laborious researches of that period.

Now, however, is not the time, nor is this the place, to dwell in any detail on his scientific papers; the above indication of the direction which his research took must suffice; it would be presumptuous to attempt to estimate the value of his work; enough that, among the great names in the history of chemical science, Wislicenus will stand with Bunsen and Kekulé and Victor Meyer and such names as made the nineteenth century what it was.

We do not wish to enter into a panegyric of his character; such things belong rather to the columns of a daily paper and to the exaggerated estimates of mediocrities; but a word as to his human aspect—and he *was* a man of wide sympathies—will not be out of place. In politics, he was an ardent admirer of Bismarck, and had little tolerance for the social democrats of latter days; not that charitableness was lacking in his disposition, for many were the kindly acts that he performed. He was fond of children, and when his own family had grown up and he was left alone with his daughter, the cheerful presence of a little niece helped to relieve the gloom that the tragedy of his domestic life had cast over the later years. To music he was almost insensible, and Wagner was to him nothing more than a confusion of sounds. He was present at the first performance of "Siegfried," but left in the middle of the second act with a violent headache. Literature was his one refuge in the intervals of work, and when troubled with insomnia, from which he suffered much, he would pass the hours in his well-stocked library. It is related that at one of his weekly dinner parties, to which all his research students were invited in turn, a youth of an inquiring turn of mind, desirous of probing the extent of the professor's knowledge, read up an almost forgotten author and tackled him on the subject when the cigars were produced; great was the student's chagrin on discovering that it was one of his teacher's favourite authors and at having to sit through an impromptu half-hour's lecture on the author's peculiarities of style. This youth never carried his investigations any further. With his students, Wislicenus was always popular, and though they christened him at one time the "Schmier-Director," from the number of tarry residues that the arbeits were producing, that did not detract from the affection and esteem in which he was held. In his daily round of the research laboratories, he was ever ready with words of sympathy and encouragement that went far to allay the soreness and disappointment of repeated failures; his kindly suggestions have stimulated many to greater efforts.

In 1898, the Royal Society awarded him the Davy medal, and his death makes a vacancy in its list of foreign members.

The loss will be felt not in Germany alone, for his students came from all parts of the world, and while men of science will remember him as one of the founders of stereochemistry, his disciples will look back on him as one of the "influences" of their lives, as a man of broad sympathies and great powers, as an example to emulate and as a memory to inspire.

NOTES.

AMONG the names included in the long list of "Durbar Honours" published on New Year's Day, we notice the following:—Dr. George Watt, C.I.E., officer in charge of the Economic and Art Section of the Indian Museum, Calcutta, has had the honour of knighthood conferred upon him. Dr. W. R. Hooper, C.S.I., President of the Medical Board at the India Office, and Sir Colin Campbell Scott Moncrieff, K.C.M.G., President of the Indian Irrigation Commission, have been made Knight Commanders of the Star of India. Colonel St. George C. Gore, Surveyor-General of India, has been made a Companion of the same order. Dr. B. Franklin, Director-General Indian Medical Service, and Mr. John Eliot, F.R.S., Meteorological Reporter to the Government of India and Director-General of Indian Observatories, have been promoted to the rank of Knight Commanders of the Order of the Indian Empire. Major A. W. Alcock, F.R.S., Superintendent of the Indian Museum, and Prof. J. C. Bose, Presidency College, Calcutta, have been made Companions of the same order. Major David Semple, Director of the Pasteur Institute, Kasauli, has been awarded the Kaisar-I-Hind Medal for Public Service in India.

A GERMAN newspaper records the following exemplary incident, apropos of a recent act of the Kaiser, in appealing to his people for support in a good work. Dr. Dohrn, of Naples, having appealed with little result to the German Minister of Education for financial aid in the extension of his world-famed biological station, sought an interview with the Kaiser. Remarking sympathetically that he could not provide all that Dr. Dohrn desired from his private purse, the Kaiser furnished him with a donation form, headed by himself and a contribution of 1000*l.*, commanding that it should be circulated among the leaders in Berlin society, for return to the Kaiser in person. The result was that within a few days the magnificent sum of 15,000*l.* was subscribed.

MR. HERBERT KYNASTON has been appointed by the Colonial Office director of the Geological Survey of the Transvaal.

M. EDMOND PERRIER has been appointed to the chair of comparative anatomy at the Paris Muséum d'Histoire Naturelle, and M. Pierre Marcellin Boule to the chair of palæontology at the same institution.

A MESSAGE from the *Times* correspondent at Ottawa states that the promoters of the Canadian Marconi Company hope by the end of next summer to have a complete system of wireless telegraphy in operation throughout Canada, extending from the Gulf of St. Lawrence to the Pacific Coast.

MR. MARCONI was entertained at a banquet at Sydney on December 30 by the citizens of Cape Breton Island. Reuter reports that in responding to the toast of his health, Mr. Marconi said that when his system of wireless telegraphy was further developed, it would be possible for ships in distress to signal passing ships. The cable companies, when they began, charged pounds per word; they were now down to shillings,

and his starting at ten cents might soon lead to a charge of one cent per word and thus bind England and her colonies more closely together.

THE *Daily Mail* states that Sir Ernest Cassel has offered to give 40,000*l.* towards the study and investigation of ophthalmia in Egypt.

THE death is announced of M. Pierre Laffitte, who, since 1893, has filled the chair at the College de France for the exposition of the general history of science.

AN anti-tuberculosis union for Austria has been formed, with Count Lützow as president. The Vienna correspondent of the *Times* reports that nearly 5000*l.* has already been received in subscriptions, and the Government has promised the fullest support in combating the disease.

THE death is announced of Prof. Dr. Max Schede, professor of surgery at the University of Bonn, to which post he was appointed in 1895. During the time that Prof. Schede was organiser of the surgical section of Hamburg Hospital, he made it his aim to develop the system of antiseptics introduced into surgery by Lord Lister.

MR. OTTO HILGER, whose death we announced last week, was born at Darmstadt on January 20, 1850, where he passed his apprenticeship under his father, who was the master of the mint. At eighteen years of age, he went with his brother, the late Mr. Adam Hilger, to Paris, where they started a workshop, doing much good work for the observatory. At the outbreak of the Franco-German war in 1870, being Germans they had to leave Paris and came to London. In a few years, they were able to start a small business as scientific instrument makers, and the name of Hilger soon became well known in the scientific world. In 1888, Mr. Otto Hilger was appointed by Lord Blythswood to take charge of his private laboratory, where he was until 1897, when the death of his brother compelled him to return to London to carry on the business, though this necessitated leaving partially completed a dividing engine for ruling diffraction gratings which he had been constructing under Lord Blythswood. During recent years, the demand for a high degree of accuracy in scientific instruments has greatly increased, and many men of science will regret the death of a maker who was able to appreciate the necessity for refinements in workmanship.

ON Tuesday, January 13, Prof. Macfadyen will deliver the first of a course of six lectures at the Royal Institution on "The Physiology of Digestion." On Thursday, January 15, Mr. A. J. Evans will begin a course of three lectures on "Pre-Phœnician Writing in Crete, and its Bearings on the History of the Alphabet." The Friday evening discourse on January 16 will be delivered by Prof. Dewar, on "Low Temperature Investigations." On January 23, Dr. Tempest Anderson will lecture on "Recent Volcanic Eruptions," and on January 30 Prof. W. E. Dalby will lecture on "Vibration Problems in Engineering Science."

ACCORDING to a Reuter message from San Francisco, advices from Corinto (Nicaragua), dated December 15, state that the volcano Santiago, near Granada, was then in active eruption. At night the sky was lit up by the volcano, and great havoc had been wrought. Momotombo, on Lake Managua, was also discharging clouds, and the volcano Izalco, in San Salvador, was in more active eruption, clouds and lava issuing from the crater at short intervals. At night a brilliant spectacle was presented, the lava pouring down the side of the mountain looking like a stream of fire. A telegram from Valparaiso states that it is reported that five volcanoes in the province of Llarquihue are active.

THE Moscow correspondent of the *Standard* states that a well-marked record of the recent earthquake at Andijan was obtained by the seismological instruments at the observatory there. The time recorded was 11 a.m., that is, about 8.30 a.m. Greenwich time. Andijan is the second largest town in the "Territory" of Fergana, and had not less than fifty thousand inhabitants at the time of the earthquake.

DURING the past ten months, the Odessa correspondent of the *Standard* points out, Transcaucasia and Transcaspia have been visited by several severe earthquakes. In February last, Schemakha, on the Caspian side of the Caucasus, was laid in ruins by a series of violent earthquakes and volcanic disturbances, in which upwards of three thousand people perished. In July, a similar calamity desolated several districts in Kashgar, involving the loss of some six thousand lives. Those events have now been followed by the destructive series of earthquakes in the districts of Novi-Marghelan and Andijan. According to the latest reports, the loss of life is equally as appalling as that at Kashgar. A few days previous to the dreadful event in Andijan, a series of slight earthquake shocks was felt at Schemakha, the site of the disaster in February last.

PROF. ROBERT KOCH and two assistants, Surgeon Dr. Kleine, of the Prussian Headquarters Staff, and Dr. Neufeld, of the Prussian Institute for Infectious Diseases, are on their way to investigate cattle plague in Rhodesia. To the Berlin correspondent of the *Daily Mail*, Prof. Koch has remarked:—"I contemplate my mission with more or less misgiving, because the Rhodesian plague is of an absolutely mystifying character. Such symptoms as I have so far examined indicate that the disease is wholly different from any species of rinderpest that has ever come under medical observation. What is peculiarly baffling is that the Rhodesian plague dates only from the late war. The cattle imported from Egypt, Australia and South America, which it was supposed would prove immune, have fallen early victims to its ravages, which threaten to denude the entire colony of live stock. While in South Africa, I shall not neglect the opportunity of continuing my tuberculosis experiments with the view of adducing still more positive evidence of my theory of the non-communicability of bovine tuberculosis to human beings, which I, of course, adhere to resolutely."

CAPTAIN BOYD ALEXANDER has just returned to England, after a short visit to the west coast of Africa, where he has been collecting birds and mammals on the islands of St. Thomas and Fernando Po, in the Bight of Biafra. Captain Alexander has obtained altogether nearly 400 specimens, and is expecting more from a collector that he left in Fernando Po. The results of his work as regards birds will probably be published in the *Ibis*.

MR. J. S. BUDGETT, Balfour student of the University of Cambridge, has returned to England from Lake Albert (where he has been engaged in studying the development of the Polypterine fishes) by the Nile route, and will give an account of his expedition at the scientific meeting of the Zoological Society on January 20. Not having been altogether successful in Uganda, Mr. Budgett will probably make another visit to the Upper Gambia, where he has better prospects of obtaining the required information, in the course of the present year.

MR. W. G. DOGGETT writes from Entebbe (November 5, 1902) that he was then preparing to start for the southern frontier of Uganda, to take up his post as naturalist to the Anglo-German Boundary Commission under Major Delmé Radcliffe. The expedition will start from the shores of Lake Victoria at 1° S.L., and will define the boundary between Uganda and German East Africa as far west as the Semliki

River. In the Semliki Forest, Mr. Doggett hopes to be able to obtain fresh specimens of the new African mammal (*Okapia johnstoni*), which are much required at South Kensington.

THE Institution of Electrical Engineers has issued the preliminary programme of the visit to Italy to be made this spring. It is proposed to leave London on April 2, and the first technical visit will be to the Valtellina Railway and power-house on April 4. At Como also the tomb of Volta can be visited the next day. On April 6, the party will leave for Milan, travelling *viâ* the Milan-Varese Electric Railway and visiting the works of Messrs. Tosi, at Legnano, in passing. On April 7, the Paderno power-house will be inspected. On April 8, visits will be made to various places of technical interest in Milan, including the Technical High School, and on the next day to the power-houses at Vizzola and Tornavento. The party will break up on Thursday, April 9, or on the Friday morning (Good Friday).

AMONG the many papers of interest in the December number of the *Geographical Journal* may be specially mentioned Dr. Stein's account of his explorations in Chinese Turkestan, and the readers of NATURE will not fail to note the importance of his discovery of inscribed wooden tablets on the Niya River site. Here, in a small decayed building, he found more than 200 documents on wood of all shapes and sizes. Besides tablets with the Indian Kharoshthi writing, he unearthed several narrow pieces of wood bearing Chinese characters, and many of the former were still protected by the strings with which they were originally tied and bore clay seals. On the seals, we have figures of Pallas Athene, with shield and ægis, Eros and Athene Promachos, and these prove beyond all doubt the influence which classical Western art has exercised even in distant Khotan. Many of the documents bear dates which are mentioned in connection with the names of rulers, and the texts, which seem to be written in an early form of Indian Prakrit, cannot fail to throw great light on the early, unknown history of the district wherein they have been found. It is important that the materials which Dr. Stein has secured should be worked thoroughly, for they may contain information concerning the frequent communication which must have existed between the East and the West during the early centuries of the Christian era.

THE unfortunate fatal accident which occurred at the Fulham Public Baths on December 23 serves to show how dangerous an electric shock may be when the conditions are such that really good contact is made. In this case, two bathers were killed by standing up in their baths and putting their hands on a metal rail running along the top of the partition between the baths; on top of this rail ran the iron pipes containing the electric-supply leads. It seems that there was leakage, possibly in a faulty lampholder, to these pipes, which were insufficiently "earthed." The bathers therefore completed the earth through their bodies to the bath itself, and thus received a shock which, in spite of the fact that the pressure could only have been something like 170 volts, had fatal results on account of the very good contacts which existed. The circumstances of the case are altogether exceptional, and there is absolutely no need for users of electric light to take any alarm. The moral to be drawn is that in an installation of this kind, where it is possible for people to make direct contact between their damp skin and parts of the installation, more care should be taken in design and supervision to prevent any possibility of contact with any live metal.

THE outbreaks of typhoid fever at Winchester and at Southampton again direct attention to the possibility of the typhoid infection being spread through the agency of shell fish, in these instances through oysters. Dr. Nash, in a report on an outbreak of typhoid fever at Southend-on-Sea, finds that the incidence of the disease was thirty-six times as great among shell-fish consumers as among those who do not eat shell-fish, and expresses the opinion that if the eating of shell-fish were abandoned in Southend, the incidence of typhoid fever would lessen by fully one-half. In the Southend outbreak, cockles were mainly responsible for the spread of the infection.

A LARGE portion of the contents of the January number of *Climate* is devoted to a consideration of the possibility of stamping out malaria. Major Ronald Ross discusses the prevalence of malaria at Ismailia, and comes to the conclusion that if the mosquitoes in the district were even partially eradicated, as might easily be done, malaria would almost disappear. Sir William MacGregor describes the Italian campaign against malaria, and draws attention to the prophylactic use of quinine, the protection of dwellings with wire gauze, the cultivation of the soil and the drainage of swamps as means of diminishing the prevalence of malaria.

AT an international maritime congress recently held at Copenhagen, M. Willaume-Jantzen, subdirector of the Danish Meteorological Institute, contributed an interesting paper on the climate of the coast of Iceland, based on eighteen to twenty-two years' observations at four representative stations—Vestmannoe (south), Stykkisholm (west), Grimsey (north) and Papey (east). Generally speaking, the lowest mean barometric pressure in the north Atlantic lies to the south-west of Iceland, and to the north-east of the island there is another area of mean low pressure, but a little higher than that on the south-west. These two areas determine the prevalent winds on the east coast, which blow with nearly equal persistency from north-east and from north-west. But from its position with regard to the advance of barometric depressions from west to east in the Atlantic, the pressure in Iceland is subject to sudden and great variations, causing frequent storms, the average annual number of days of storm on the east coast being seventy-five. Generally speaking, the summer climate on the coast is fresh and the winter mild, but the latter may be very severe with northerly winds and the approach of polar ice. In some localities, fog is very prevalent; at Berufiord, near Papey, it occurs on 212 days, but at Stykkisholm on nine days only. Rainfall is heavy on the south and light on the north; at Vestmannoe there are 225 days on which rain falls on a yearly average.

THE volume containing the meteorological observations and results for the United States Naval Observatory, Washington, under the direction of Prof. J. R. Eastman, for the year 1901, has been recently received. As in former years, it contains the details of all the observations which are made every three hours during each day. These include the corrected readings of the barometer, and of the wet and dry bulb thermometers, the symbols indicating the character of the clouds, the estimated amount of cloudiness, wind direction and velocity, together with the daily means. The six tables which follow record the results, such as the maximum and minimum temperatures for each month, daily and monthly means of the corrected barometric readings, &c. The volume contains also the meteorological observations made at the same hours at the new naval observatory with a view to determine the difference of the thermometric conditions at the two localities, in order that future records at the new observatory can be properly compared with the records at the old observatory, which extend from 1845 to 1892 inclusive.

WE have received from the editors of the *Photogram* a new edition of a set of cards which are intended for the pocket-book of the photographer. These cards, 5×3 inches in size, contain a great amount of very useful information, some of which the

practical photographer is sure to find serviceable either in his studio or out in the field. Thus we have a brief guide for correct exposure for various kinds of plates and light, tables of enlargement and reduction for telescopic lenses, how to find south without a compass in order to fix the time of best lighting, the metric and British systems of weights and measures and their connection one with the other, photographic temperatures and a comparison of different thermometer scales, &c. These cards, eight in number, can be obtained from the office of the *Photogram* by forwarding one penny stamp, and they are valuable and useful for the money.

THE theory of the dimensions of units in the electrostatic and electromagnetic systems has on various occasions been criticised. A short note dealing critically with dimensions of physical units in general is given by Dr. Ladislaus Gorczyński in the *Physikalische Zeitschrift*, iv. 5. In thermodynamics, the author points out that the dimensions of temperature should not be omitted from the expressions for the dimensions of such quantities as thermal conductivity, specific heat and entropy, and he introduces the dimensions of K and μ into the electrical systems. Herr Gorczyński supports the position assumed by Schreber and disagrees with certain views expressed by Hesehus. In particular, he considers that the assumption of a relation of the form $v = \sqrt{e/d}$ connecting the "v" of electromagnetism with elasticity and density is unjustifiable. The general conclusion is that the conventional treatment of dimensions of units is unsatisfactory, and that it is not at present possible satisfactorily to express the dimensions of all physical units in terms of those of the three fundamental units of length, time and mass alone. It is certainly safer to introduce too many fundamental units the dimensions of which are treated as independent of one another than to cut down the number by regarding the measure of any physical quality as a dimensionless number.

THE first report on a chemical and physical study of the soils of Kent and Surrey has been issued by the South-eastern Agricultural College, at Wye, by Mr. A. D. Hall and Mr. F. J. Plymen (1902). The object is eventually to accumulate such a series of analyses of the soils, chemical and mechanical, as will enable the College, when given the situation of any field, to indicate in a general way the kind of manures wanted for each particular crop. The two counties are not much covered with drift deposits, and these are depicted on the one-inch Geological Survey map, but the pressing need of a geological map on the six-inch scale is pointed out. The present report deals only with the soils resting upon the London Clay, Chalk and Gault. By procuring samples of soils from each geological formation in a number of localities, a good general knowledge of them has been obtained. Particulars of these, with methods of analyses, are given. With regard to the Gault soils, it is remarked that the most profitable use to make of them "is to keep them or lay them down as permanent pasture." On both London Clay and Chalk there is considerable variety of soil, and recommendations are made on the cultivation of different areas.

A SECOND edition of Dr. A. J. Ewart's "First Stage Botany" has been published by Mr. W. B. Clive. Several additions and alterations have been made.

THE second volume of Prof. Wundt's "Grundzüge der physiologischen Psychologie" has been received from Mr. W. Engelmann, Leipzig. The first volume was noticed a short time ago (November 6, 1902, p. 2), and an estimate of the value of this great work can be obtained from that review. After the work has been completed, a notice of the new volumes will appear.

THE three essays which were successful in the recent competition for the erection of a sanatorium for tuberculosis, initiated by His Majesty the King, are reprinted in full in the current number of the *Lancet*, with reproductions of the plans of the buildings. The essays are valuable epitomes of modern knowledge of the cause, prevention and cure of tuberculosis.

WE have received from Messrs. Isenthal and Co. their latest catalogue and price list of apparatus for radiography and general electro-medical work. The list is a very complete one and shows that the firm is in a position to supply all the apparatus needed in this class of work, from single pieces of the simplest type to full sets made up into suitable cabinets. We note also that the firm arranges for courses of lessons in the use of the apparatus for those who desire it.

THE "Annuaire du Bureau des Longitudes" for 1903 has been published by M. Gauthier-Villars, Paris. This compact little volume contains, as usual, a mass of information indispensable both to the man of science and to the engineer. Among the contents of the volume may be specially mentioned the contribution by M. R. Radau, on shooting stars and comets, and that by M. J. Janssen, on science and poetry. The discourses delivered at the funerals of MM. Cornu and Faye are also included in this year's issue of the annual.

THREE new volumes of the first annual issue of the International Catalogue of Scientific Literature have been received, and are similar in character to those already described. The subjects of the volumes are physics (part i.), meteorology (including terrestrial magnetism) and mechanics. The second part of the catalogue of physical papers will shortly be published and will complete the volume on physics. The two volumes on meteorology and mechanics are each complete in themselves, and the portions of the scientific literature of 1901 not included in them will form a part of the second annual issue of the Catalogue.

MR. W. ENGELMANN, Leipzig, has issued two new volumes in Ostwald's series of scientific classics. As is well known, each volume in this series contains one or more papers which have influenced the progress of science, selected from the works of investigators of various nationalities and translated into German when written in other languages One of the volumes recently published contains series xiv. and xv. of Faraday's experimental investigations in electricity, translated from the *Philosophical Transactions* of 1838 and edited by Dr. A. J. von Oettingen; the other volume (No. 132) contains a translation of two papers by Andrews, on the continuity of the gaseous and liquid states of matter, from the *Phil. Trans.* of 1869 and 1876, edited by Dr. Arthur von Oettingen and Prof. K. Tsuruta.

WE have before us the forty-second yearly issue of the *British Journal of Photography*, edited by Mr. Thomas Bedding (Henry Greenwood and Co., Strand), and a glance at this bulky volume, which contains nearly 1600 pages, of which about 600 are text matter, is sufficient to indicate its vigorous and healthy condition. The book is arranged on similar lines to those of its predecessors, and will be found a mine of interesting, practical and useful information on photographic topics. Among some of the contents may be mentioned a very complete list of the officers of photographic societies in the United Kingdom, America and on the continent, a large collection of photographic formulæ and recipes in both the English and metric systems, chapters on photomicrography with bibliography by the editor, a summary of the recent novelties in apparatus, &c., since the publication of the last almanac, practical notes and suggestions of the year, and an epitome of the year's progress, in which is given a *résumé* of the more important discoveries and improvements. Scattered

among the text are some excellent reproductions illustrating the behaviour of different lenses and speeds of shutters, and the frontispiece is a contact print on Barnet platino mat bromide paper. The low price of the volume (one shilling) and the useful nature of the contents should render it indispensable to every photographer.

IN the current number of the *Comptes rendus* is a note by Prof. Henri Moissan on a new method of preparing the silicon analogue of ethane, Si_2H_6. This substance was originally obtained by the author, in conjunction with Dr. Smiles, by the partial condensation at -200° C. of an impure silicon hydride prepared by the action of hydrochloric acid upon a silicide of magnesium of undefined composition. Attempts to prepare the same compound from the lithium silicide, Li_2Si_6, by the action of dry hydrogen chloride or a dilute solution of hydrochloric acid were unsuccessful, hydrogen being the only gaseous product. It has now been found that by the gradual addition of lithium silicide to concentrated aqueous hydrochloric acid, the silico-ethane is readily formed in abundance and can be separated by means of cooling to the temperature of liquid air.

THE same number contains an account, by M. F. Bodroux, of another application of the organo-magnesium compounds to organic synthesis. It has been found that if a magnesium alkyl chloride or bromide, prepared in the usual way by the action of magnesium upon an ethereal solution of the alkyl bromide or chloride, is treated with iodine, the alkyl iodide is produced in nearly quantitative yield, together with magnesium iodochloride or bromide. Propyl bromide and isoamyl chloride treated in this way have furnished about 80 per cent. of the theoretical quantities of the corresponding iodides. The reaction is equally applicable to aromatic derivatives, and will simplify greatly the preparation of many monoiodo-derivatives of benzene.

THE much-discussed question of the chemical character of bleaching powder is revived in a recent number of the *Zeitschrift für anorganische Chemie*, which contains a long paper on the subject by Herr Winteler, of Darmstadt. The investigation appears to have arisen from a difficulty which was experienced in making good bleaching powder from electrolytic chlorine, owing to the gas containing considerable quantities of carbon dioxide. The chief conclusions reached by Herr Winteler are as follows. Dry chlorine does not act on dry calcium hydroxide, but in the presence of moisture chlorine water is first formed. This contains hypochlorous and hydrochloric acids, which then act upon the calcium hydroxide. The action involves complicated equilibria, which depend on the temperature, the amount of water present, the rate at which the chorine is passed, &c. Bleaching powder possesses no definite formula, but is a mixture of bodies resulting from the balanced reactions just referred to. It contains basic calcium chloride and basic hypochlorite as normal components, and may contain chloride and hypochlorite as well as hydroxide and the free acids. The decomposition of bleaching powder into chloride and oxygen takes place when there is an excess of hydroxyl ions; on the other hand, an excess of hydrogen ions leads to a decomposition into chlorate and chloride. Working upon this theory of the character of bleaching powder, Herr Winteler shows how it is possible to prepare a good product even when using unpurified chlorine containing 6 per cent. of carbon dioxide.

THE additions to the Zoological Society's Gardens during the past week include a Fennec Fox (*Canis cerdo*) from North Africa, presented by Dixon Bey; two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Mr. J. B. Joel; two Egyptian Jerboas (*Dipus aegyptius*) from North Africa, presented by Miss Chesterman; two Eastern One-wattled Cassowaries (*Casuarius aurantiacus*) from New Guinea; a Blossom-headed Parrakeet (*Palaeornis cyanocephalus*) from India; a Gangetic Trionyx (*Trionyx gangeticus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *d*.—From observations made at Hamburg on December 3 and 11, and at Paris on December 22, Herr Ebell has calculated the following elements and ephemeris for this comet:—

T = 1903 March 23·544 Berlin M.T.

$$\left.\begin{array}{rl} \omega = & 5^\circ\ 43'\ 32''\cdot6 \\ \Omega = & 117\ \ 29\ \ 51\cdot2 \\ i = & 43\ \ 54\ \ 17\cdot4 \end{array}\right\} 1903\cdot0$$

$$\log q = 0\cdot443876$$

Ephemeris 12h. M.T. Berlin.

1903		α h. m. s.		δ ° ′		log Δ		Brightness.
Jan. 0	...	7 3 10	...	+3 47·3	...	0·2925	...	1·4
4	...	7 0 19	...	+4 54·1	...	0·2880	...	1·4
8	...	6 57 23	...	+6 4 6	...	0·2847	...	1·5
12	...	6 54 27	...	+7 18·2	...	0·2825	...	1·5
16	...	6 51 34	...	+8 34·4	...	0·2816	...	1·5
20	...	6 48 47	...	+9 52 6	...	0·2818	...	1·5

Unit brightness at time of discovery.

On December 22d. 10h. 44m.·3 Paris M.T., the comet was observed in the following position by M. Bigourdan at Paris:—
α (apparent) = 7h. 9m. 7s.·4, δ (apparent) = + 1° 32′ 55″.

M. Fayet has found that this comet has the greatest perihelion distance recorded for any comet since that of 1729.

OBSERVATIONS OF VARIABLE STARS.—In No. 3837 of the *Astronomische Nachrichten*, M. M. Luizet, of the Lyons Observatory, publishes his observations of five variable stars and gives his results for each star in a tabular form.

The result of 285 observations of Algol, made between November 18, 1897, and March 12, 1902, indicates a possible slight negative correction to the elements published by Mr. Chandler in No. 509 of the *Astronomical Journal*.

One hundred and fifty-seven comparisons of the irregular variable ε Aurigæ indicate great irregularities in the brightness of this star, which on December 10, 1901, was actually one or two degrees fainter than ν Persei.

One hundred and fourteen comparisons of W Orionis were made between October 26, 1898, and March 19, 1902, and these show that both the duration of the period and the magnitudes at maxima and minima vary greatly. The following elements show the closest agreement to the observations:—

$$\left.\begin{array}{l} \text{Maximum 1899 February 22} \\ \text{Minimum 1899 March 10} \end{array}\right\} + 32\text{d.}\cdot 32\ \text{E.},$$

but there are several observations which are not reconcilable to this period.

Observations of T Monocerotis and ζ Geminorum have also been made, and tables of their maxima and minima are given by M. Luizet.

THE SPECTRUM OF ε AURIGÆ.—From the investigation and measurement of spectrograms obtained during 1901 and 1902 by Prof. Hartmann and Dr. Eberhard, Prof. H. C. Vogel has found that ε Aurigæ is a spectroscopic binary which has a very long period.

The spectrograms referred to show that the hydrogen lines in the violet region, beyond H and K, stand out with exceptional prominence in this star, and a close investigation as to the cause has led to the conclusion that the spectra of two stars—one of the α Cygni type, the other lying between the limits of Types I. and II. (α Persei, γ Cygni)—are present, the one being exactly superimposed on the other.

OBSERVATIONS WITH A BINOCULAR TELESCOPE.—In *Popular Astronomy*, No. 100, Mr. D. W. Edgecomb describes the performances of the 6¼-inch binocular telescope, made by Messrs. Alvan Clark and Sons.

In describing the features of the Moon, Jupiter and Saturn as seen with the binocular, the writer states that the objects

present more detail, are brighter, and appear larger than when seen through an ordinary single telescope of the same aperture. In addition to this, the "seeing" is much steadier, and the stereoscopic effect obtained greatly enhances the beauty of the objects observed.

Such objects as Clark's companion to γ Lyræ, the companion to τ Orionis and the Mitchell companion to Rigel have all been steadily observed, and it is generally considered necessary to use an instrument of 7 or 8 inches aperture in order to see the last-named object.

The prisms used in this instrument are $2\frac{7}{8}$ inches long and $1\frac{3}{16}$ inches thick, the rays from the objectives traversing $5\frac{1}{2}$ inches of glass before reaching the eyepieces.

RECENT AMERICAN BOTANY.

MR. M. L. FERNALD[1] has published a very interesting review of the birches belonging to the groups *Betula alba* and *B. nana*. These trees and shrubs inhabit the northern regions of both hemispheres, and Mr. Fernald recognises in America seven species and seven varieties, of which six species and five varieties are common to the Old World. Thus, contrary to the opinion of some recent authors, the American white birches are mostly non-endemic, though exhibiting numerous apparently distinct forms. Not only is this true, but the admitted species intergrade all along the line. "It is quite possible to trace by a series of specimens a direct connection between the dwarf *Betula nana* or *B. glandulosa* and the tall *B. alba*. . . . But since it is obviously impracticable to regard all these forms as one species, it seems wiser to recognise the more marked centres of variation as species which are admitted to pass by exceptional tendencies to other forms ordinarily distinguished by marked characteristics" (p. 189). This, of course, brings up the question of the definition of species. The present writer has been accustomed to use the accompanying diagram in teaching biology. The line *a a* represents a species which is slightly dimorphic, as is indicated by the two prominences. The line *b b* represents a strongly dimorphic species, connected (at *b'*) by very few intermediates. The line *c c* represents a case in which the intermediates have died out, and there is a complete break (at *c'*) resulting in the formation of two species. It is now to be pointed out that this break must be spacial or geographical, and not merely morphological, otherwise the two sexes of the same species would often have to be regarded as distinct species. Such a break need not be geographical in the ordinary sense, but when the two species inhabit what is nominally the same locality, they are found to be differently related to their environment, or related to different closely adjacent environments. Furthermore, they must breed true, and not ordinarily interbreed one with another.

This sounds simple enough, but the application of these principles is not so simple. In the diagram, the case of *b b* is obviously more like that of *c c* than it is like that of *a a*. The difference between a slight break and a slight connection is infinitesimally small, yet after all it is a real difference—something existing in Nature, and not subject to individual opinion. If this criterion is admitted, because of its capability of exact definition, then the whole series of birches discussed by Mr. Fernald must apparently be regarded as one species!

Another sort of case is offered by the plants of the Galapagos Islands, recently reviewed in a most valuable memoir by Dr. B. L. Robinson.[2] *Euphorbia viminea*, J. D. Hooker, has eight distinct forms confined to as many islands (one only being found on two). These plants are readily distinguishable, but their characters are such as would be ordinarily of no value for distinguishing species in the genus. On continental areas, similar species of Euphorbia are polymorphic, with innumerable similar variations connected by every sort of intermediate. Consequently, Dr. Robinson does not treat the Galapagos plants as separate species, or (with one exception) even as varieties, but as "forms." Now, according to the above definition of species, these plants are perfectly good species, for the breaks in continuity, slight as they are, appear to be absolute.

There is, perhaps, one way of escaping from this conclusion. Distinct species should not promiscuously interbreed; there should be some sort of "physiological" barrier. It is known, in the case of the ostensibly distinct species of Lavatera from the islands off the coast of California, that this barrier does not exist. Perhaps, if the different Galapagos Islands' forms of *Euphorbia viminea* were grown together, they would completely fuse and give a single promiscuously varying type like those of the continents. But, after all, the question is what they actually do, not what they might do, under hypothetical conditions. The answer to this question must be that they remain distinct.

It seems to the present writer that the only precise criterion of species must be a spacial one, just as the only reason for species is that of function, or the relation between the nature of the creature and the place it occupies. But, admitting this on philosophical grounds, we are forced to recognise species of every degree of distinctness, just as the geographer recognises islands separated by every sort of distance from the mainland. It is easier, no doubt, to accept instead the morphological criterion, and this is actually what we have to do in taxonomic work,[1] for lack of evidence of the other kind; but this leaves the whole matter to be decided by individual opinions, with results known too well.

It is probable, if not certain, that variable plants on continental areas produce many "temporary species." That is to say, local colonies become more or less differentiated and remain so until swamped by invasions of the parent form or some other variety. Whether we recognise these "temporary species" depends, in practice, upon the degree of difference exhibited. Not rarely, the distinctions are constant and marked over a certain area, but the very same distinctions elsewhere occur as individual variations in the midst of the parent species. I have recorded such cases in the genera Sphæralcea and Cleome.

At the close of his work on the Galapagos flora, Dr. Robinson presents a most lucid and philosophical discussion of the whole subject; it is so full of fact and thought that a brief summary could not do it justice. In particular, attention must be called

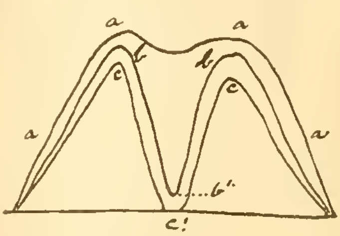


FIG. 1.

to his statement of the reasons why the local insular varieties persist in spite of the occasional infusion of new blood.

Mr. Carl Purdy's revision of the genus Calochortus[2] is another work of great interest. These beautiful "butterfly lilies" are extremely abundant in the Pacific region of North America, and are almost indefinitely variable. The variations are of all sorts, sometimes "constitutional" rather than morphological. Says Mr. Purdy, "In cultivation it has frequently been found that a very slight variability in strains is accompanied by a marked constitutional difference. In two beds of *Calochortus venustus*, planted in the same soil and separated only by a thin board, it would puzzle a botanist to state wherein the plants vary. They come from widely separated localities, and the difference is one more easily detected by the eye than conveyed by words. In one bed, two-thirds of the leaves are already destroyed by mildew (Botrytis), while in the other, not one leaf is injured; and such is the case whenever and wherever the two are planted" (p. 108). Mr. Purdy points out that in some localities the plants are very uniform, while in others they are extremely variable, with hundreds of distinguishable phases. It is probable that the phenomenon of "temporary species" is common in this genus, and the union of such morphologically, but not physiologically, distinct types is the cause of much variability. At the same time, there are species which always remain distinct, never producing fertile hybrids. That Mr. Purdy has tested so many of the forms for such "physiological barriers" gives his work especial value and importance. It does

[1] *Amer. Journ. Science*, xiv., September, 1902.

[2] *Proc.* Amer. Acad., October, 1902 (vol. xxxviii.).

[1] De Vries has assumed that, because botanists so distinguish species (admittedly of necessity), therefore the morphological criterion is the genuine one. Thus species have no better foundation in Nature than genera, which are wholly based on reasons of convenience.

[2] *Proc.* Calif. Acad. Sci., 3rd series, Botany, vol. ii. No. 4 (1901).

not appear that mere isolation suffices to produce even distinct varieties of Calochortus. For instance, *C. catalinae*, Watson, is found on Catalina and other islands, and also on the mainland; but instead of running into numerous insular races, it "is one of the least variable" of all, and no variety has been distinguished by name. On p. 141, Mr. Purdy admits that his *Calochortus venustus*, var. *eldorado*, "var. nov.," is the same as *C. venustus purpurascens*, Watson; while he applies the name *purpurascens* (Purdy, 1895) to a quite different variety of the coast range. This surely cannot be permitted; the former must stand as *purpurascens*, while the latter may be called var. *Caroli*.

T. D. A. COCKERELL.

EARTHQUAKE OBSERVATIONS IN GALICIA.

THE ninth number in the new series of the publications of the Austrian Academy of Sciences relates to earthquakes observed during the year 1901 in Lemberg. The first feature which one observes in this publication, the author of which is Dr. W. Láska, is that he describes each earthquake according to the phases it exhibits, the various phases being distinguished from each other by differences in their periods. Twenty years ago, earthquakes were described as consisting of preliminary tremors, shocks and concluding vibrations, each of which had distinguishing periodic motions. Now we find first preliminary tremors of types p_1' and p_1'', second preliminary tremors of types p_2', p_2'', p_2''' and p_2'''', and on they go, commencing with p_1', with periods between 2·1 and 6·9 seconds, and ending with types where the periods have exceeded one minute. Inasmuch as these groups overlap, so that it is frequently difficult to assign a set of waves to their proper group, for our own part we are for the present content to divide the seismic spectrum into four parts—first and second preliminary tremors, large waves and concluding vibrations. In addition to these entries, Dr. Láska gives tables of tri-daily readings of two levels and of a thermometer. The most interesting portion of the work is, however, found in its introduction, where, amongst other matters, reference is made to the natural period of a pendulum as influencing the magnitude of its records and to rules which enable an observer to determine the distance of an origin from the inspection of a seismogram.

One simple rule is to diminish the duration of the first preliminary tremors reckoned in minutes by unity and multiply the same by 1000. The result is an approximation to the distance of the origin expressed in kilometres. For example, if a seismogram shows that the preliminary tremors had a duration of 7·6 minutes, then the earthquake it represents originated at some place about 6600 kilometres distant. The mnemonic is certainly simple, but its application is confined to those records where preliminary tremors are well defined. These are comparatively few in number and the accuracy of the determination is dependent upon the measurement of intervals of time which are small. These objections apply to a second rule suggested by Dr. Láska, the value of which is apparently still further impaired by the introduction of two assumed constants determined by Dr. F. Ōmori. These constants are the velocities of the first and second preliminary tremors as determined from observations of ten earthquakes which originated near Japan and were recorded at Tokio and in Italy.[1] To obtain these velocities, the arcual distance between the Tokio isoseist and Italy is divided by the difference between the times of observation in Tokio and Italy. Had the distance between the origins and Italy been divided by the difference of times between the times of origin (which are easily calculable) and the times of arrival in Italy, then the constants given by Dr. Ōmori would have been reduced. A further reduction would be made on the assumption that the wave paths of the motion considered had approximated to chords. If the speed of the preliminary tremors between their origin to the Tokio isoseist had been the same as it was from that isoseist to Italy, then the above objections might be withdrawn, but this, according to Dr. Ōmori's own showing, appears hardly to be the case.[2]

Although it is interesting to find the relationship between the duration of preliminary tremors and the distance they have travelled again brought to our notice, the well-known method of determining origins by the interval of time between the first motion of an earthquake and the subsequent arrival of the large waves is apparently one of more frequent and certain application.[1]

J. MILNE.

[1] "Publications of the Earthquake Investigation Committee in Foreign Languages," No. 5, pp. 71–80. (Tokio, 1901.)

[2] *Jour.* Sc. Coll., Tokio, vol. xi, p. 158.

[1] "Brit. Assoc. Reports," 1900, p. 79; and "Seismological Investigation Report," 1902.

PILOT CHARTS OF THE METEOROLOGICAL OFFICE.

IN addition to the usual information, the Meteorological Office pilot chart of the North Atlantic and Mediterranean for the month of January deals with some new features, necessitating the use of the back of the chart as well as the front. There is an account of the destructive cyclone which visited our coasts on October 15–16 last, and also of the slow-moving disturbance and its accompanying gales which wandered about the Tyrrhenian Sea from October 22–29. A summary is given of the characteristics of the surface temperature of the Atlantic for each of the ten months from January to October last, the most striking feature being the evidence of a distinct tendency for the water in the immediate vicinity of western Europe to remain cooler than the normal during the first nine months, a fact which may be associated with the persistent low air temperature over the adjacent land during the spring and summer. On the Newfoundland banks, there was a marked excess of warmth through the first six months, little or no ice being found in the locality. In October, an excess was shown on the eastern side of the ocean for the first time, and simultaneously the air temperature over the British Isles passed above the average in all districts. With the object of discovering what connection, if any, there is between the movements of weather systems and the distribution of the temperature of the surface water, observations are being collected for obtaining the mean barometric pressure month by month over the region from 30° to 60° N., 0° to 70° W., and the tracks of the centres of storm areas. For October, the mean isobars are superimposed on the sea temperature results, while the storm tracks are given on a separate chart.

To arrive at any definite conclusion as to cause and effect, it will require a long series of such charts—probably, too, for shorter periods than a calendar month, periods determined by the prevailing type of conditions, depending mainly on the positions and stability of the controlling anticyclones. Summaries are given of the ice reports from the whaling steamer *Balaena*, up Davis Strait, and the barque *Lady Head*, in Hudson Bay, last summer. Neither vessel passed any ice in the lower part of Davis Strait when heading for home in October. On July 1 last, the New Zealand Shipping Company's s.s. *Waikato* was disabled in 33° S., 6° E., and for twenty-six days she drifted helplessly about the south Atlantic, being finally taken in tow on July 27 in 28° S., 13° E., having in the interval travelled 812 miles, or at an average rate of more than thirty-one miles per day. The track of her wanderings day by day, together with the direction and force of the wind, supplied by Captain Kiddle, is reproduced, with the addition of the normal current circulation of the region, which shows that the *Waikato* followed closely the drift indicated by the Admiralty chart.

STARVING A PARASITE.

IN a recent paper read before the Royal Society,[2] Prof. Marshall Ward described the results of three series of experimental cultures of Brome-seedlings in sand, to which had been added various nutritive salts, or manurial mixtures, which were then infected with the parasite to see how the latter behaved on starved seedlings. Some of the seedlings received all the salts necessary for successful development, others none of such salts other than the root-hairs could extract from the sand itself and from the reserves in the endosperm, and others all necessary minerals except phosphorus, or potassium, or magnesium, or calcium, or nitrogen respectively.

So far as the seedlings themselves are concerned, the effects of the mineral starvation were most evident in the small stature,

[2] "Experiments on the Effect of Mineral Starvation on the Parasitism of the Uredine Fungus, *Puccinia dispersa*, on Species of Bromus." By Prof. H. Marshall Ward, F.R.S. Read before the Royal Society on November 27.

reduced root-system, narrow leaves, pale colour, &c., the nitrogen-starved and phosphorus-starved specimens, and in those lacking all salts.

In no case, however treated were the starved or manured seedlings rendered immune. All were successfully infected by normal uredospores adapted to the normal species, though in the phosphorus-free and in the nitrogen-free seedlings, and in those deprived of all salts, there were signs of retardation of the infection, and the resulting patches and pustules of fungus spores (uredospores) were fewer and smaller.

As regards the fungus, apart from the reduced size of the mycelium, as expressed in the small pustules and retardation of development above referred to, even the reduced number of spores borne on the smallest pustules—*e.g.* on phosphorus-starved plants—showed no signs of morphological degeneration, or of diminished germinating capacity or virulence—*i.e.* capacity for infection.

The positive results, therefore, are purely *quantitative*. A starved plant develops smaller pustules and fewer spores, simply because it can offer smaller quantities of food materials to the mycelium in its tissues; these food-materials, however, are as good in *quality* as they are in the case of a normal or highly manured plant. Not only so: the experiments also show that spores developed on starved seedlings can also infect seedlings which have been *similarly starved*—for instance, the few spores obtained from the very minute pustules of a phosphorus-starved seedling *can infect another phosphorus-starved seedling* just as readily as they can a normal plant, and so on through the series.

Consequently, we must infer that predisposition and immunity on the part of the Brome, and impotence and virulence on the part of the Fungus, are alike independent of mere nutrition; and since the author has shown in previous papers[1] that these properties are also independent of the anatomical structure of the host-plant, it must be concluded that the phenomena of adaptive parasitism depend on deep-seated peculiarities of the living protoplasm of the cells—possibly their capacity for forming enzymes, toxins and antitoxins, chemotactic bodies and the like, although such bodies have as yet resisted all efforts at extraction.

The full paper is illustrated with photographs and tables.

THE NORTH OF ENGLAND SCIENCE CONFERENCE.

THE first annual conference of persons in the north of England concerned in primary, secondary, technical and other forms of higher education, was held at Manchester on January 2 and 3, and proved highly successful. The conference may be regarded as a natural outcome of similar meetings which have for some years past been held annually in London under the auspices of the London Technical Education Board. Many teachers and other educationists from the north of England have, year by year, attended the conferences in London and have become familiar with the benefits to be derived from a discussion of educational methods. Believing that many teachers and others in the northern counties, anxious to reap the advantages springing from such meetings, were debarred from attendance by the expense of travelling, a number of prominent educationists in Lancashire and Yorkshire arranged this series of meetings in Manchester, and the phenomenally large attendance at all the discussions has fully justified their enterprise. More than three thousand persons accepted invitations to be present, and every meeting was characterised by the greatest enthusiasm. It had been intended to hold all the meetings at the Manchester Municipal School of Technology, but the number of visitors to be accommodated necessitated the duplication of meetings, and a few days before the commencement of the conference arrangements were made for additional papers to be read in other places at the same time as those originally provided.

In addition to the papers and discussions, the executive committee provided exhibitions to illustrate methods of nature-study, the teaching of experimental science, school furniture and other forms of school equipment. Demonstrations on the teaching of light and magnetism were respectively given by Messrs. Adamson and Moore, of the Manchester Technical School; and, in addition, the numerous excellent educational institutions in different parts of the city were thrown open for the inspection of visitors. A conversazione, held at the School of Technology on the evening of the first day of the conference, provided a good opportunity for teachers in different districts to become acquainted.

The method of conducting the meetings deserves to be more widely imitated in educational conferences. Immediately after the reading of a paper, the discussion of the subject was opened by one or two speakers of wide experience, who had been previously selected for the purpose and had prepared their remarks, with the result that the discussion was much more helpful to teachers than is usually the case on similar occasions. Moreover, as printed copies of the papers for discussion could be obtained immediately before the commencement of the meetings, subsequent speakers were able to contribute something of value to the debate, and general remarks having little relation to the subject in hand were reduced to a minimum. Messrs. J. H. Reynolds and H. Lloyd Snape, the honorary secretaries, are to be congratulated upon the complete success of the conference.

Half an hour before the commencement of the serious business of the conference, the visitors were welcomed by the Lord Mayor of Manchester, and his remarks were warmly endorsed by Dr. Maclure, Dean of Manchester, by Prof. Hopkinson, principal of Owens College, and by other prominent educational authorities of the district.

School Curricula.

Mr. M. E. Sadler presided at the first meeting of the conference, and in his introductory speech dealt with the aims of education. The purpose of all practical inquiry and experiment was, he said, to find the kind of training which would best equip the rising generation for their life as home-makers or wealth-makers, under the actual conditions of the modern world. The reform of the curricula of our schools would, he thought, involve certain practical changes in the conditions under which many English teachers at present worked. Little boys ought not to be prematurely specialised in classical erudition in order to win scholarships at the public schools. In no school should any pupil fail to gain insight into the meaning of scientific method and into the operation of physical laws. In any type of curriculum, drawing and other forms of expression by means of the hand should be given a permanent place and should be worked in, as far as possible, in connection with the other subjects of study. There was a need that scientific and experimental study of education should be actively carried on at the universities, with encouragement of similar investigation among teachers already at work in the schools.

Miss Burstall, head mistress of the Manchester High School for Girls, then read a paper on the curriculum in different types of schools, in which she endeavoured to find general principles by which school curricula may be tested and, if necessary, amended. Three principles were deduced; first, the gradual adjustment of the child to the spiritual possessions of the race; second, that of training; and third, the theorem that the order of subjects in school life is conditioned by the laws of development of the child. These principles, Miss Burstall contended, lead to a broad rather than a narrow curriculum. The compulsory subjects of the curriculum for all children could be divided into three groups—English, including literature, history and geography, the humanities; science, *i.e.* arithmetic and nature-study for young children, mathematics and science later; physical and manual training. Technical education should be reserved for the last year of school life, when the specialised study of mathematics and science required for engineering, or housewifery and the domestic arts for girls, might be taken up. The subsequent discussion was very animated, and many teachers took part in it. Mr. King, high master of the Manchester Grammar School, contended that the subjects of education did not so much matter as the method in which they were taught. Prof. Armstrong, F.R.S., deprecated a statement of Miss Burstall's that a child's reasoning powers developed late.

A paper by Mr. W. E. Hoyle, of the Manchester Museum, on the value of natural history collections for teaching purposes, was also read at Owens College during the first morning of the conference.

[1] *Proc.* Cambridge Philos. Soc., vol. xi. 1902, pp. 307–328; and *Annals of Botany*, vol. xvi. 1902, pp. 233–315.

Coordination of Science Teaching.

Prof. Armstrong, F.R.S., took the chair at the afternoon meeting, when Dr. Kimmins read a paper on the coordination and delimitation of science teaching in various grades of schools. He maintained that the aim of rational methods of teaching science was not the acquisition of knowledge, but rather the training of the intelligence of the child and the development of certain mental qualities of the highest value. Useful knowledge had been and was still the curse of science teaching. He urged that the adoption of rational methods in science teaching simplified to a remarkable degree the relation and delimitations of such teaching, and instanced the coordination in workshop and laboratory instruction which has been so effectually secured in London schools. In the discussion which followed, Dr. Forsyth emphasised the need of a sound general education for all students who intended later to enter technical colleges.

During the afternoon, Canon Rawnsley read a paper at the Central Higher Grade School on the national import of co-education.

Elementary Experimental Science.

Prof. Smithells occupied the chair at the third meeting, when papers were read by Mr. French, on the teaching of experimental physics in its early stages, and by Mr. R. L. Taylor, on the similar teaching of experimental chemistry. Mr. French described and approved the methods of teaching elementary physics advocated by the British Association committee and now very generally adopted in secondary schools. Mr. Taylor attacked, in a friendly way, the heuristic method of teaching chemistry as advocated by Prof. Armstrong, an admirable method which, he said, had become an undesirable system. A lively debate ensued, in which many speakers, following Mr. Taylor's lead, appeared to strive to accentuate the abuses of the "research" method of teaching chemistry rather than to recognise its many advantages

Prof. Armstrong, in replying to Mr. Taylor's criticisms, said the question at issue was not merely a difference of opinion. There was a great principle at stake, and that principle was—Were they or were they not to train boys and girls at school to think for themselves, to reason for themselves, to do for themselves, to be thoughtful, observant human beings throughout the time they were at school, whenever they left school, and ever afterwards? The majority of the subjects that were taught and had been taught up to the present day had been taught in an academic, didactic and unpractical way. Britain was what it was because of the individuality of Britishers. Our modern school system was sapping our individuality. It was with the object of avoiding that loss of character that he and others were bringing practical methods into vogue.

Prof Smithells, in a very able speech, summarised the discussion, and traced many of the improvements in the teaching of science in England during the last ten years to the advocacy by Prof. Armstrong of rational methods of teaching, but at the same time pointed out there were extravagances in some of Prof. Armstrong's utterances which were, perhaps, inseparable from the work of a pioneer.

At the Central Higher Grade School during the discussion on the heuristic method, Mr. Lomas read a paper on fitting up school laboratories.

The Teaching of Nature-Study.

The concluding meeting of the conference was presided over by Prof. Miall, F.R.S. A paper was read by Mr. H. Wager on the methods of nature-study, in which he urged that nature-study in its widest aspects should be regarded as the study of elementary natural science, and should include, in addition to the simple facts of botany, zoology and geology, so much of elementary physics and chemistry as was concerned with the study of air and water, the condensation of moisture, frost, snow, and other simple natural phenomena. The formal study of any branch of science was not implied in it, nor was it desirable, in the earlier stages, at any rate, that they should be restricted to one branch of science only. The main objects in advocating the inclusion of nature-study in schools were (1) to arouse an interest in natural objects and phenomena, and (2) to develop to some extent the scientific method of dealing with simple problems, by the careful observation and comparison of facts and drawing inferences from them.

Prof. Weiss afterwards suggested that some portion of public parks should be made available for nature-study. He disagreed with Mr. Wager, who had deprecated the employment of diagrams and museums, and said he could not but think that there were many objects from which lessons could usefully be learnt without having the living animal before them. They should first go to the living objects, but useful illustrations could be drawn from other countries, and where they had opportunities they should use them.

During the concluding afternoon, Mr. W. C. Fletcher, of Liverpool Institute, read a paper on the teaching of geometry, in which he generally supported the recommendations of the British Association committee.

The next conference will be held at Leeds.

A. T. S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual meeting of the Association of Science Masters in Public Schools will be held at the University of London on January 17.

WE learn from the *Times* that the Treasury has given its assent to the scheme by which Reading Corporation acquires the site and buildings of the University College at a cost of 50,000*l*. The college, in exchange, obtains a much larger site on the London Road, whereon it is intended to erect a handsome pile of college buildings.

FROM a letter which Sir Michael Foster has addressed to Sir John Rotton, it appears that an election of a new member for the University of London may not be necessary. This news will be received with great satisfaction by most of the electors, for the University has in Sir Michael Foster a representative of the high intellectual standard demanded of an academic constituency. Since expressing the wish to resign his seat, the circumstances which suggested that course have, most fortunately, changed, and he now desires to know whether the graduates wish him to remain their member or not.

CANDIDATES for the Andrew Carnegie research scholarships to be awarded by the Iron and Steel Institute must send in their applications, on a special form, before the end of February to the Secretary of the Institute, 28 Victoria Street, S.W. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school or works, provided it be properly equipped for the prosecution of metallurgical investigations. Last year the Andrew Carnegie gold medal was awarded to Dr J. A. Mathews, New York, and scholarships, each of the value of 100*l*., were awarded to O. Boudouard, Paris; W. Campbell, New York; A. Campion, Coopers Hill; P. Longmuir, Manchester; E. Schott, Berlin; and F. H. Wigham, Wakefield.

PROF. ROBERTSON, the Canadian Commissioner of Agriculture and Dairying, recently made a visit of investigation and observation to a portion of the State of Ohio, where remarkable progress has been made in the improvement of rural schools by the plan known as that of consolidation. Instead of having a great number of small school districts, each with its own little school, these districts are united in one, and a large central school meets the needs of the whole area. The children are conveyed to and from the central school by means of vans at the expense of the rates. Prof. Robertson sums up some of the advantages afforded by the consolidation of rural schools and the free transportation of pupils. It results in the attendance of a larger number of the children in the locality, it brings about a more regular attendance of pupils of all grades of advancement, it ensures teachers of higher qualifications and longer experience in rural schools, it creates conditions for a proper classification of pupils and provides the beneficial influences of fairly large classes of pupils of about equal advancement. It makes it convenient for boys and girls in rural districts to obtain a high school education without leaving home, and leads to the erection of better school buildings and more satisfactory equipment. It makes it practicable for rural schools to teach nature-

study, manual training and household science, and for advanced pupils to obtain instruction in agriculture, horticulture and allied subjects. It stimulates public interest in the schools and brings to the pupils of a township an institution in which all can have an equal interest and a worthy pride.

THE address given by Sir J. Wolfe Barry on Tuesday, as president of the Association of Technical Institutions, contained several instructive comparisons as to the position of technical education at home and abroad. For instance, he pointed out that while the matriculated students in German technical high schools number 15,442, the number in the whole of similar institutions and universities of Great Britain is only 3873. But it is not so much the number of students as the spirit in which scientific knowledge is regarded that is of importance to national progress. What is wanted, Sir J. Wolfe Barry remarked, is, first, that the highest intellects among us for research as applied to the arts should be rendered available, and secondly, the best possible directing minds should be discovered and utilised in our manufactures. In other words, the man of science should be encouraged to help in the development of industries. Efforts should be made to ensure that industrial leaders are well equipped with scientific knowledge and the principles of technology, and in our schools less time should be given to dead languages and more to the efficient study of science, applied mathematics and other subjects demanded by modern life. Finally, everyone should endeavour, each in his own sphere of influence, to direct, without any exaggeration, but with profound conviction, the attention of our commercial classes to the fact that technical education of the best and most thorough kind is an urgent and crying necessity if we are to maintain a leading position among the nations of the world.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11, 1902.—"An Error in the Estimation of the Specific Gravity of the Blood by Hammerschlag's Method, when employed in connection with Hydrometers." By A. G. **Levy**, M.D. (London). Communicated by Sir Victor Horsley, F.R.S.

Hammerschlag's method may be briefly described as the adjustment of the specific gravity of a mixture of chloroform and benzol by small successive additions of either constituent until it corresponds to the specific gravity of the blood, the test of the attainment of this condition being that a small drop of the blood, when immersed in the mixture, shall remain suspended without any very obvious tendency to rise or sink. The specific gravity of the mixture is then estimated by means of a hydrometer.

This method is known to be liable to an error of varying magnitude. The investigation into the source of this error resolved itself into a series of observations upon the effect of the low value of the surface tension of the above mixture upon the readings of hydrometers immersed therein. The surface tension of the mixture may be taken as 2·75 mg. per mm., and that of clean tap water as 7·3 mg.

The readings of four different hydrometers when immersed in a mixture of the specific gravity 1·000 are appended:—

No. of hydrometer.	No. 1.	No. 2.	No. 3.	No. 4.
Reading of scale in a chloroform benzol mixture of specific gravity = 1·000	1·002	1·003	1·0095	1·010

The author found, however, that the *calculated* errors exceeded in each instance those *observed*, and the results are contrasted in the following table:—

Hydrometer.	Observed error.	Calculated error.
1	0·002	0·0035
2	0·003	0·0056
3	0·095	0·0123
4	0·010	0·0146

The difference was accounted for satisfactorily by an innate error demonstrated to exist in each hydrometer, evidently due to the standardisation of the instrument in unclean (*i.e.* greasy) water, which possesses a lower surface tension than 7·3 mg. This appears to be a common fault in hydrometers.

Chemical Society, December 17, 1902.—Prof. Emerson Reynolds, F.R.S., president, in the chair.—The following papers were read:—A reagent for the identification of carbamide and of certain other nitrogen compounds, by Mr. H. J. H. **Fenton**. Among the derivatives of methyl-furfural previously described by the author is one which may be either methyl-furil or the isomeric ketone-aldehyde; this in presence of a trace of acetyl chloride gives with carbamide and monoalkyl carbamides a brilliant blue colour.—The rate of decomposition of diazo-compounds, part ii., diazo-compounds of the naphthalene series, by Messrs. **Cain** and **Nicoll**. The reaction is monomolecular, but after a time is not strictly so owing to the formation of azo-colours.—State of carbon dioxide in aqueous solution, by Prof. J. **Walker**. It is shown that obedience to Ostwald's dilution law in the case of solutions of carbonic acid gas and similar substances affords no evidence as to the amount of real carbonic acid present in solution.—Qualitative separation of arsenic, antimony and tin, by Prof. J. **Walker**. The mixed sulphides are dissolved in soda solution and oxidised with sodium peroxide; from the solution, stannic oxide is precipitated by boiling with ammonium chloride, whilst arsenic and antimony can be separated in the usual manner.—The hydrates and solubility of barium acetate, by Prof. **Walker** and Mr. W. A. **Fyffe**. The solubility curve consists of three portions, all convex to the axes and representing the solubilities of a trihydrate, monohydrate and anhydrous salt respectively.—*cis*- and *trans*-ββ Dimethylglutaric acid, and the separation of the *cis* and *trans* forms of substituted glutaric acids, by Messrs. J. F. **Thorpe** and W. J. **Young**.—Constitution of metallic cyanides, by J. E. **Marsh**. Metallic cyanides, with the exception of those of silver and mercury, are oxidised by permanganate to cyanates, whence the author concludes that in general these cyanides have the isonitrile structure, the exceptions being nitriles.—Auto-reduction of mercury and silver cyanides, by Messrs. **Marsh** and **Struthers**.—Note on the action of acids on cellulose, by Miss M. **Gostling**. The black residue formed when cellulose is heated with strong haloid acids closely resembles the artificial humus obtained by the action of dilute acids on sugars.—Nitrotartaric acid and some of its esters, by Prof. P. F. **Frankland**, Mr. H. L. **Heathcote** and Miss **Hartle**.—The nitration of diethylmonobenzoyl and mono-*p* toluyl tartrates, by Prof. P. F. **Frankland** and Messrs. **Heathcote** and **Green**. A preliminary description of these derivatives of tartaric acid.—Interchange of halogen for hydroxyl in chloro- and bromo-naphthalenediazonium hydroxides, by Dr. **Orton**.—Purpurogallin, by Messrs. A. G. **Perkin** and A. B. **Steven**. A description of acyl and alkyl derivatives is given and the products of decomposition by potassium hydroxide are found to be two ketonic substances of the formula $C_{11}H_6O_5$.—Note on the destructive distillation of ethyl gallate, by Mr. A. G. **Perkin**. In addition to pyrogallol and ethyl alcohol, there is formed 7 per cent. of rufigallic acid; the latter is also produced by the distillation of gallic acid itself.—A series of double chromates, by Mr. S. H. C. **Briggs**. A double salt of the composition $(NH_4)_2Ni(CrO_4)_2,6H_2O$ and a second of the composition $(NH_4)_2Ni(CrO_4)_2,2NH_3$ have been obtained, as well as the corresponding salts of copper, zinc and cadmium, by the action of ammonia on the appropriate dichromates.

Linnean Society, December 18, 1902.—Prof. Sydney H. Vines, F.R.S., president, in the chair.—Notes on some Copepoda from the Faröe Channel, by Mr. Thomas **Scott**. Waterlogged and partly decayed pieces of wood are frequently brought up in the dredge, and these fragments harbour Entomostraca. In this manner, some of the rare forms, commented on in this paper, were obtained. Three new species and a new variety of another previously characterised species were described.—The Amphipoda of the *Southern Cross* Antarctic expedition, with remarks on bipolarity, by Mr. A. O. **Walker**. The collection was made between Cape Adare in April, 1899, and Franklin Island in February, 1900, the larger part after the death of the zoologist of the expedition (Mr. N. Hanson) by Mr. Anton Fougner, partly by dredging. The species obtained have a striking resemblance to forms found in Arctic seas, though only one species has been deemed identical, *Ampelisca macrocephala*, Lilljeb. The author does not put forward any theory of his own to account for the similarity of forms in the Arctic and Antarctic regions, with their absence from the intervening tropical seas, but he adduces many instances of it, especially the distribution of the genus Orchomenopsis, Sars, which is widely spread in waters of low temperature. One new genus, Oradarea, is described with a single species, from Cape Adare.

—The deep-sea isopod, *Anuropus branchiatus*, Bedd., and some remarks on *Bathynomus giganteus*, A. M.-Edw., by Dr. H. J. **Hansen.** The aberrant genus Anuropus was described by Beddard in the report of the *Challenger*, vol. xvii., from a single specimen brought up from 1070 fathoms off the coast of New Guinea. The author has recently examined this specimen during a visit to the British Museum, and supplements the original description in several important particulars.

Royal Microscopical Society, December 17, 1902.—Dr. Hy. Woodward, F.R.S., president, in the chair.—Mr. **Rousselet** exhibited an apparatus designed by Mr. H. Bausch for drawing objects natural size. It was described in the Society's *Journal* in 1900, but had not been previously exhibited.—The Rev. R. **Freeman** read a paper by Mr. F. R. **Dixon-Nuttall** and himself on the genus Diaschiza which was illustrated by drawings shown on the screen by means of the epidiascope. The authors alluded to the confusion in which this genus of rotifers had remained to the present time and pointed out the errors into which Gosse had fallen. They described the characters of those species which they considered should be included in the genus and also described a new species.—Mr. E. R. **Turner** gave a description of Lumiére's process of taking photomicrographs in colours.

EDINBURGH.

Royal Society, December 1, 1902.—Lord Kelvin, president, in the chair.—Prof. Cossar **Ewart** read a paper on the callosities of the horse, in which from a study of their occurrence in the fœtus he concluded that the wrist callosity corresponded to the supplementary pad in the foreleg of the dog, and that the hock callosity corresponded to a pad which occurred in the banded ant-eater. There was no evidence of the callosities being remnants of glandular organs. The evidence was rather in favour of Beddard's recent suggestion that they were remnants of tactile organs such as occur in marsupials, lemurs, and the ungulate hyrax.—Prof. **Ewart** also read a paper on a new horse from the Western Islands, *Equus Caballus Celticus.* This newly recognised variety was a pony which took in the west the same place which the Arab took in the east. It agreed with asses and zebras in having no callosities on the hind legs, and it resembled the Przevalsky horse of Central Asia in having short hairs on the upper part of the tail just as in mules. It was yellow dun in colour, had black fetlocks, small head, small ears, prominent eyes, and had stripes and dorsal band, and fragments of stripes on legs, shoulder and face. In many characteristics, it differed decidedly from the Przevalsky horse, and nothing like it was to be found in the east, the recognised home of the Arab. It was found in Iceland, Faeroe, Barra and other small islands of the outer Hebrides, also in Connemara. From the drawings of Palæolithic man and from the bones found in caves, we are able to distinguish two kinds of horses, a large and a small size, and it was suggested that the Celtic pony represented the small-sized horse known to Palæolithic man. The evidence disproved the once prevalent view that all the various breeds of European horses were descended from the one domesticated stock which originated in the east. Dr. Munro thought that Prof. Ewart's paper was of great anthropological importance as furnishing additional evidence as to the continuity of man and his domesticated animals from Palæolithic times, and so giving the *coup de grace* to a fetish which had existed for many years in this country, that Palæolithic man had died out and all his civilisation become extinct before the appearance of Neolithic man.

PARIS.

Academy of Sciences, December 29, 1902.—M. Bouquet de la Grye in the chair.—M. Mascart was elected a vice-president for the year 1903.—On the presence of argon in the gases from the Bordeu spring at Luchon, and on the presence of free sulphur in the sulphurous water from the cave and its vapours, by M. Henri **Moissan.** An analysis of the gases from this spring, carefully collected in the absence of air, showed the presence of 2·56 per cent. of argon, 1·22 per cent. of methane, the remainder of the gas consisting of nitrogen. The water and the vapour from it contained free sulphur.—On a new preparation of the silicon hydride, Si_2H_6, by M. Henri **Moissan** (see p. 233).—Experimental cultures in the Mediterranean region: modifications in the anatomical structure, by M. Gaston **Bonnier.** Experimental cultures of the same species of plant were made in the same soil at Fontainebleau and at La Garde, near Toulon, and a minute account of the anatomical differences observed is given.—On the conditions necessary that a fluid should be in stable equilibrium, by M. P. **Duhem.**—On the velocity with which the different varieties of X-rays are propagated in air and in different media, by M. R. **Blondlot.** X-rays of varying penetrative power were examined, and the velocities determined in air, paraffin wax, beechwood, vaseline oil and essence of turpentine, and it was found that within the limits of experimental error the velocity of the different varieties of X-rays was the same in all the media, being equal to that of light in air.—On the germinating power of seeds exposed to sunlight, by M. Emile **Laurent.** Sunlight exerts an injurious influence upon the seeds or dried fruits of the higher plants, the first effect being a delay in the germination and then the death of the embryos. In general, moderately bulky seeds are less sensitive to the effects of sunlight than smaller ones, especially if the latter have dark coatings.—Notice on M. Millardet, by M. **Bornet.**—Anomalies of the earth's magnetic field on the Puy de Dome, by MM. B. **Brunhes** and **David.** Report by M. Bouquet de la Grye.—New observations on the volcanic eruptions at Martinique, extracts from letters addressed by M. **Lacroix** to MM. Darboux and Michel Levy.—Observations of the comet *d* (1902) made at the Observatory of Algiers with the 31·8 cm equatorial, by MM. **Rambaud** and **Sy.** Observations of magnitude, apparent positions of the comet and of comparison stars.—Observations of the Perseids, Leonids and Bielids made at Athens in 1902, by M. D. **Eginitis.** The Perseids were observed under favourable conditions between August 8 and 13; they were less numerous than in the five preceding years. The conditions for the observation of the Leonids and Bielids were not so favourable.—On entire functions, by M. **Hadamard.**—Remark relating to my note on the approximate representation of functions, by M. W. **Stekloff.** A correction of an error in a previous note.—On the fundamental formula of Dirichlet relating to the determination of the number of classes of definite binary quadratic forms, by M. Mathias **Lerch.**—An application of the theory of residues to the analytical prolongation of Taylor's series, by M. Ernst **Lindelof.**—On a plane representation of space and its application to graphical statics, by M. B. **Mayor.**—Study of the magnetofriction of the anode bundle, by M. H. **Pellat.** In previous papers, the author has described a series of phenomena which are produced when a kathode or anode flux is submitted to the action of an intense magnetic field and which are inexplicable by the laws of electromagnetism. The assumption of the existence of an anisotropic friction affecting the particles in motion, very great in the sense perpendicular to the lines of force of the magnetic field and much less in the direction of the lines of force, serves to explain the observed phenomena perfectly, and the name magnetofriction is proposed as a general name for this phenomenon. Experiments are described in which the effect of varying the pressure and nature of the gas is shown.—On the emanation from phosphorus, by M. Eugène **Bloch.** It has been known for some time that air placed in the neighbourhood of a stick of phosphorus becomes a conductor of electricity. The study of this phenomenon having led to contradictory explanations in the hands of Barus, G. C. Schmidt and Harms, further experiments have been carried out by the author, who concludes that the conductivity of dry air which has passed over phosphorus is due to ions of very feeble mobility which serve as nuclei of condensation for water vapour, even non-saturated. The question of the exact chemical mechanism by which these ions are produced, whether their formation is due to the production of a definite chemical compound such as ozone or an oxide of phosphorus, or to a simple modification of the oxygen, requires further study.—On the Hall effect and the mobility of the ions of a saline vapour, by M. Georges **Moureau.**—On a new electric accumulator, by M. D. **Tommasi.** A description of the method of constructing the lead plates of an accumulator. The capacity obtained is 17·7 ampere-hours per kilogram of plates.—On the spectra of flames, by M. C. de **Watteville.** The method of M. Gouy is applied to the study of flame spectra in the ultra-violet. The results given tend to show that temperature is the only factor which influences the constitution of spectra.—On the proportion of hydrogen in atmospheric air, by M. Anatole **Leduc.** A reply to the criticisms of M. A. Gautier, the author maintaining the accuracy of his original conclusions.—The thermal study of metaphosphoric acid, by M. H. **Giran.**—On some sources of mineral gases, by

M. Ch. **Moureu.** An analysis of the gas arising from mineral springs in the region of the Pyrenees. All the gases examined contained argon in amounts varying from 0·9 to 1·8 per cent. Only one of the five samples examined could be shown to contain helium.—On cryolites, by M. E. **Baud.** A thermochemical paper.—On a new method for the volumetric estimation of hydroxylamine, by M. M. L. J. **Simon.** Hydroxylamine oxalate can be titrated with potassium permanganate in neutral solution in a perfectly definite manner, and an exact method for the titration of any salt of hydroxylamine can be based upon this fact.—On the method of manufacture of arms of the bronze period, by M. F. **Osmond.** By the application of the methods of micrographic analysis to specimens of ancient bronze implements, it has been found possible to trace differences in the mode of manufacture, and it is regarded as possible that a methodical study on these lines may lead to the classification of bronze implements with regard to time.—On the composition and constitution of the hydrates of sulphuretted hydrogen, by M. de **Forcrand.** The method of study is based upon the measurement of the dissociation pressures.—On the dibromide of metho-ethenylbenzene, by M. M. **Tiffeneau.**—On the synthesis of an aromatic hydrocarbon derived from camphor, by M. C. **Chabrié.** A study of the interaction of benzene and monochlorocamphor in the presence of aluminium chloride.—On a method for transforming monochloro- and monobromo-derivatives of hydrocarbons into monoiodo derivatives, by M. F. **Bodroux** (see p. 233).—On the decomposition of some di- and tri-basic organic acids, by MM. Œchsner de **Coninck** and **Raynaud.** Malonic, succinic, tartaric, malic and citric acids were heated with glycol, glycerol and with sulphuric acid, and the decomposition products noted.—On the nature of the nitrogen compounds which exist in the soil at different heights, by M. C. **André.**—Normal hermaphrodism in fishes, by M. Louis **Roule.**—Organic variations in carnivorous fowls of the second generation, by M. Frédéric **Houssay.**—On the origin of the *Nebenkirn* and the nuclear movements in the spermatid of *Notonecta glauca*, by MM. J. **Pantel** and R. de **Sinéty.**—On the otocysts of polychætal annelids, by M. Pierre **Fauvel.**—On the nuclear emissions observed in the Protozoa, by MM. A. **Conte** and C. **Vaney.** The conclusion is drawn that the nucleus takes part directly in the formation of zymogen grains, and consequently it is of high importance in the phenomena of digestion, both intracellular and extracellular.—The organisation of *Trepomonas agilis*, by M. P. A. **Dangeard.**—On intermediary wood, by M. Paul **Vuillemin.**—The influence of formaldehyde upon the vegetation of some fresh-water Algæ, by M. Raoul **Bouilhac.** In presence of light, certain moulds can grow in solutions containing small quantities of formaldehyde, and can utilise the latter as food.—On the vegetation of Lake Pavin, by M. C. **Bruyant.**—On a conidian form of the fungus of black rot, by M. C. **Delacroix.**—On some connections between the genesis of metalliferous layers and general geology, by M. L. de **Launay.**—On the age of the old volcanic formations of Martinique, by M. L. **Giraud.**—On the discovery of a new granitic *massif* in the valley of the Arve, between Servoz and Les Houches, by MM. E. **Haug** and P. **Corbin.**—Cryogenin in fevers, by M. **Carrière.** Cryogenin (metabenzaminosemicarbazide) has a marked effect in lowering the body temperature, especially in the case of fevers, and appears to be free from toxic properties. Its antithermic action is variable, but is especially strong in tuberculous subjects.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 8.

MATHEMATICAL SOCIETY, at 5.30.—A Method of representing Imaginary Points by Real Points in a Plane: Prof. A. Lodge.—On the Mathematical Expression of the Principle of Huygens: Dr. J. Larmor.—Generational Relations for the Abstract Group simply Isomorphic with the Linear Fractional Group in the Galois Field [2^n]: Prof. L. E. Dickson.—Series connected with the Enumeration of Partitions (second paper): Rev. F. H. Jackson.—On the Jacobian of Two Binary Quantics considered Geometrically: Prof. W. S. Burnside.—On the Resolution of some Skew Invariants of Binary Quantics into their Factors in Terms of their Roots: Prof. W. S. Burnside.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes of Recent Electrical Design: W. B. Esson.—Notes on the Manufacture of Large Dynamos and Alternators: E. K. Scott.

FRIDAY, JANUARY 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Preliminary Note on the Possible Existence of two Independent Stellar Systems: F. A. Bellamy and H. H. Turner.—New Double Stars detected with the 17½-inch Reflector in the Year 1902: Rev. T. E. Espin.—The Sun's Stellar Magnitude, and the Parallax of Binary Stars: J. E. Gore.

GEOGRAPHICAL ASSOCIATION, at 3.30.—The Australian Commonwealth: Sir John A. Cockburn.

MONDAY, JANUARY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Recent Volcanic Eruptions in the West Indies: Dr. Tempest Anderson.

TUESDAY, JANUARY 13.

ROYAL INSTITUTION, at 5.—Physiology of Digestion: Prof. A. Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Automobiles: H. F. Joel.

WEDNESDAY, JANUARY 14.

SOCIETY OF ARTS, at 8.—Industrial Trusts: Prof. W. Smart.

THURSDAY, JANUARY 15.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans, F.R.S.

FRIDAY, JANUARY 16.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Measurement of Water: Prof. W. C. Unwin, F.R.S.

ROYAL INSTITUTION, at 9.—Low Temperature Investigations: Prof. Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Cutting Angles of Tools for Metal Work, as Affecting Speed and Feed: H. F. Donaldson.

CONTENTS.

THURSDAY, JANUARY 15, 1903.

THE HOLY SHROUD OF TURIN.

Le Linceul du Christ; Étude scientifique. By Paul Vignon, Dr. è Sci. Nat. Pp. 207 and 9 photogravures. (Paris: Masson et Cie, 1902.)

The Shroud of Christ. By Paul Vignon, D.Sc. (Fr.). Translated from the French. Pp. 170; 9 photogravures and collotype plates and 38 illustrations. (Westminster: Archibald Constable and Co., Ltd., 1902). Price 12*s.* 6*d.* net.

WHETHER the relic described, figured and discussed in this handsomely got up volume is the veritable shroud which enwrapped the body of Christ is a question which need not be seriously considered in the columns of a scientific publication. Dr. Vignon seems to have convinced himself that the relic is genuine, and his object in publishing this work is (presumably) to convince his readers, or at any rate to place before them the evidence on which his conclusions are based. So far as the antiquarian evidence goes, it will suffice to remind readers of NATURE that during the recent controversy—which appears to have been the last of a series of controversies concerning the authenticity of the relic in question—Father Herbert Thurston, S.J., communicated a letter to the *Times* of April 28, from which we make a few extracts:—

"The Abbé Ulysse Chevalier claims to have proved to demonstration that the linen winding-sheet exhibited at Turin is a spurious relic manufactured in the fourteenth century, and, as the writer believes, with fraudulent intent."

"We are not, of course, in any way bound to believe that those responsible for the subsequent veneration of this alleged relic have been guilty of conscious fraud. It may even in the first instance have been fabricated without intent to deceive. . . . Just as in the case of so many facsimiles of the Holy Vails, what was in the first instance a mere copy for devotional purposes has come in time to figure as an original, the wish, no doubt, being father to the thought, but probably without any deliberate insincerity."

Thus, out of the seven chapters composing this work, there are but two which come within our province, viz., chapter vi., in which the author deals with the scientific evidence, and chapter vii. more particularly, in which he puts forward an explanation of the image which is to be seen on the shroud. The antiquarian lore of the preceding chapters has no particular interest for us, and we may add, further, that the question whether the shroud is the real article or whether it was "faked" in the fourteenth century is a point which in no way affects the discussion of Dr. Vignon's scientific evidence, because the explanation with which we have to deal is equally miraculous whether the image is some twenty centuries old or whether it is only six hundred years old.

It will be necessary, in order that our readers may judge the issue raised by Dr. Vignon's *étude scientifique*, to give a brief description of the relic, facsimile reproductions of which are given in photogravure plates showing respectively the full-length image and the head only on an enlarged scale. The impression, according to the description and figure, is that of a human body undraped, with hands crossed, with a long face terminating in a beard, with hair over the lips and long hair lying along each side of the face; in brief, the face of Christ as made familiar by the great masters of the old Italian school. This description, of course, applies only to the front aspect. The back view is such as would be presented by the same body if seen from behind or if it produced an impression on the linen while lying on its back, the front aspect being produced (on the assumption that it is an impression) by drawing the same shroud lengthways over the face of the prostrate body. The shroud would evidently in these circumstances (again assuming that the body impressed its image) show the two figures, front and back view, on being opened out, the figures being joined head to head, and this is declared to be the state of affairs visible on the holy shroud. The image is said to be formed of reddish-brown shades and—what is of fundamental importance to the author's theory—the lights and shades are reversed, *i.e.* the impression corresponds to a photographic negative. In consequence, the true aspect of the features only appears when the image is reversed by being photographed, and this is well shown in the plates referred to, from which the reader will be enabled to compare the image with its photographic reverse. There are many other marks on the shroud which are caused by rents, stains, burns, pieces clipped out, &c., all of which naturally appear in the photographs. We fail to see the importance of the over-elaborated details of description with which the author treats of these marks, unless it be to establish his claim for the authenticity of the relic from the antiquarian point of view. With this we have nothing to do here; scientifically, these marks appear to us to have no value whatever.

It remains to be pointed out that the author, so far as can be gathered from his writings, has never seen this relic himself, but has relied upon the descriptions of others, upon a water-colour copy made in 1898 and upon photographs taken by M. Pia, by M. Fino and others in the same year when the shroud was allowed to be on view for eight days. We suppose that Dr. Vignon is satisfied that the image, as it appears on the shroud, is really a negative impression and that the photographic plates have not been tampered with, although we confess that for an *étude scientifique* we should have expected some more substantial and first-hand verification of these fundamental statements. We will, however, let all this pass and meet the author half-way, and admit that there is a negative image of a human figure on the linen, and this brings us to the core of the subject, which is embodied in the query:—Apart from the question of age, how was this image produced?

Now according to the author's descriptions, which, we may repeat, are given in ridiculously minute detail, there are visible on the head and on the body itself certain marks which we are asked to believe to represent blood stains, lacerations and wounds, and we are even given an illustration of the particular kind of "flagrum" with metal buttons which the Romans used. In fact, the description as given by the New Testament writers is, if we are to accept the author's statements, so faithfully and so minutely verified by the figure on the shroud that the ordinary reader who is not thirsting for

new "evidences," but who is simply anxious to know the actual facts of the case, will probably come to the conclusion that Dr. Vignon is either the victim of credulity or that he has overdone his evidence to such an extent as to have damaged his own reputation as an expert scientific witness. The plates certainly do not tally with the details of the markings as described in the text; but here again it may be that there is much lost by the heliographic reproduction and that the author is describing the original photographic plate, which he is careful to inform us was taken by M. Pia on an Edward 50 × 60 isochromatic film sensitive to yellow, with a yellow screen, a Voigtländer lens, a diaphragm of 7 mm. diameter and an exposure of 18 minutes, the shroud being illuminated from the front by two powerful arc lights at 10 yards' distance from the surface. We will therefore again waive an objection which might be raised against the author's special pleading on behalf of the shroud, and we will admit that there are marks on the face, body and limbs in the original plate which we cannot see in the heliogravures reproduced from it—certainly no such marks are distinctly recognisable in the front view, whatever interpretation may be put on the blotched appearance on the body in the back view.

The simplest, the most obvious and the only straightforward answer to the question how the image was produced is that it is a time-worn painting—how, when or why executed being beyond our province of inquiry in these columns. Dr. Vignon, however, is so emphatic in his repudiation of this idea that he fires off a whole battery of arguments in the sixth chapter in order to demolish the sceptics who from the fourteenth century downwards have taken this not altogether unreasonable view of the relic. One or two of these arguments may be dealt with on their own merits as appealing to scientific principles. He lays very much stress, for example, upon the circumstance that the impression is a negative one, arguing therefrom that no forger could possibly have painted a figure intentionally with lights and shades reversed. May we ask why not? As an artistic feat it does not seem altogether impossible, and distinguished artists whom the reviewer has consulted inform him that, not only is such a style easy of execution, but that a forger who wished deliberately to convey the impression that the image was produced by contact of the body with the shroud would, if skilful, intentionally adopt such an artifice. Then again, it is stated (p. 123, English ed.) that the image cannot be a painting (*i.e.* in pigment) because it would have faded with the lapse of time instead of becoming darker. Again we ask why? In the first place, where is the evidence that the image has become darker? In the next place, accepting Dr. Vignon's own explanation, which shall be considered subsequently, why should a "vaporographic print" (to use the author's term) be more permanent than a painting? An organic colouring-matter developed on the linen by the hypothetical process advocated in this work is not more likely to withstand the influence of time than a painting. The argument appears to be:—It has not faded, therefore it is not a painting. It is not a painting, therefore it is a chemical (vaporographic) impression. Readers of this review will see that little value can be attached to such inferences.

Having dismissed the theory of artistic forgery—at any rate to his own satisfaction—the author proceeds to demolish the view that the image is a contact impression. With this conclusion we quite agree. The only way that such an image could be produced by contact would be for the body to be uniformly coated with pigment and then for the supple shroud to have been pressed over and into every elevation and depression in the body. We are all familiar with the appearance of images produced by such means, and a glance at the figure on the shroud with all the details of the features and the hair will suffice to show that such an impression on linen, however supple, could never have been obtained by mechanical contact—even supposing the preliminary preparation of the body with pigment were conceded. Nothing short of a plaster cast could reproduce features such as appear in the plates. The martyrdom which Dr. Vignon must have suffered in allowing his face (with a false beard) to be smeared with red chalk in order to see what kind of impression could be obtained from it by such means will be credited to his zeal, although the publication of the blurred results in the form of a heliogravure plate seems quite superfluous.

Having thus shown how the image could not have been produced, the author proceeds to the development of his own hypothesis. The impression is not a photographic negative in the ordinary sense, but it is a genuine chemical impression produced by emanations from the body acting on the shroud, "sensitised" by the materials used for its impregnation. The emanations were not of the same kind as those proceeding from radio-active substances, but were more of the nature of vapours. Appeal is made to Dr. W. J. Russell's experiments in order to show the analogy between the images produced by the emanations from zinc, resinous substances, &c., and that on the shroud. Prof. Colson has cooperated with the author, and between them they have produced what by courtesy the writer of this notice proposes to call Russell-types of coins and busts (prepared by coating with zinc powder) on photographic plates.[1] Photographic reproductions of these are given in the volume under notice. From these figures, it will be seen that the impressions produced are really very poor as compared with the originals. The head on the coin, for example, is full of detail; its Russelltype, after photographic reversal, shows but a blurred and hazy image. Of course, the emanations from the body did not consist of zinc vapour, nor was the shroud coated with gelatino-bromide emulsion, so there may be no real analogy between the images—even on the "vaporographic" theory of Dr. Vignon. The emanations of the body, according to the author, proceeded from "febrile sweat" which bathed every portion of the body, hair included, and the sensitive material which enabled the shroud to receive the impression was, or may have been, a mixture of oil and aloes. There is nothing antecedently improbable in the supposition that emanations from a dead body, especially if ammoniacal as supposed by the author, may produce a coloured impression on a sensitive vegetable colouring-matter. So far there is just enough *vraisemblance* in the hypothesis to lead the

[1] Prof. Colson, by the way, has come to the conclusion that the emanations from zinc really consist of zinc particles, and it is these which penetrate the sensitive surface and produce the photographic effect. This explanation is at variance with the hydrogen peroxide theory of Russell.

unwary to think that Dr. Vignon has established his case. As his work professes, however, to be an *étude scientifique*, and as he unhesitatingly lays down the conclusion that the shroud is the real article (Popes, Bishops and Jesuits notwithstanding) and that the image is a "vaporograph" produced in the manner described, it is of considerable importance that his evidence should be critically considered.

In order to clear the ground, we will make a most liberal advance in Dr. Vignon's favour and concede for the sake of argument that such ammoniacal vapours may be emitted as required by hypothesis, and further, that the shroud may have been impregnated with some sensitive colouring-matter or colour generator capable of receiving an impression in three days. What kind of impression could be expected in these circumstances? Stretching the hypothesis to its utmost limit, certainly only a blurred human figure in outline. Now look at the image on the shroud; features with a recognisable expression, hair in detail and (as per description) blood stains, wounds and stripes. Surely, as the author himself says (p. 43), "There is no limit to hypothetical ingenuity."

A scientific witness must, however—whether his hypothesis be reasonable or otherwise—be expected to give some substantial evidence for a hypothetical belief, and the more unlikely the hypothesis, *a priori*, the stronger must that evidence be. Here is what Dr. Vignon has to offer:—

"We took the plaster cast of a hand and covered it with a glove of suède kid. We then poured some of the ammoniacal solution (ammonium carbonate in water) along the wrist so that it penetrated the plaster without completely saturating the glove. The vapours were given off very regularly through the pores of the kid without staining the linen by too much water or letting the oil penetrate the damp glove.

"Working in this way we got an excellent impression of the back of the hand (on linen impregnated with olive oil and aloes). The tips of the fingers have the square aspect due to the glove having been too long. On the inside of the thumb the seams of the glove are plainly to be seen, while on the outside the image fades away rapidly and regularly. *The print is sufficiently definite to show the likeness of a finger, but too diffuse to mark the actual outlines, and this may be said of all the fingers.* (Italics ours. Compare with the hands on the figure on the shroud where the fingers are distinct.) . . .

"The print which we have obtained of this hand justifies us in asserting that under special conditions ammoniacal vapours may produce as distinct impressions of an object as those shown on the Holy Shroud" (p. 167).

Dr. Vignon's scientific conscience must really be very easily satisfied. This is the only scrap of experimental support that he furnishes. No illustration of the "vaporographed" hand is given. It is confessed that the experiment is so delicate that an attempt to repeat it gave a worse result than the first. A plaster bust of Michael Angelo refused to furnish any recognisable impression. Yet with these inconclusive results, the author virtually claims to have settled the whole history and origin of the relic. Just when he comes to the very point where scientific evidence becomes possible, he meets with what appears to the reviewer to be a failure, and then naïvely remarks:— 'We shall continue these experiments if desirable, though they only present a limited interest" (p. 167). The magnitude of the conclusions based on such lame experimental evidence justifies the condemnation of the whole work as an *étude scientifique*. To the reviewer, it reads like an antiquarian dissertation ending in a pseudo-scientific anti-climax. The conditions required by the hypothesis are not difficult to realise experimentally. There are many organic colouring-matters sensitive to ammonia gas. The fever hospitals would surely furnish the author with subjects for experiment if inanimate models of the human figure are considered unsatisfactory. If by ammoniacal or any other vaporous emanation Dr. Vignon can succeed in producing an impression as distinctly recognisable as a likeness as the image on the shroud in all its details, we will waive the question of twenty centuries' permanence and go so far as to admit that there is at any rate some justification for "vaporographic" portraiture. As the "explanation" stands now, it is purely in the region of hypothesis, and pending that rigorous verification required by science, we consider that the author's case is "not proven." If there are any scientific readers who are convinced that the conclusions in this work are satisfactorily established, we shall be disposed to credit the shroud with having wrought a greater miracle than was ever ascribed to it by the Chapter of Lirey in the fourteenth century.

R. MELDOLA.

IRISH FOLKLORE.

Traces of the Elder Faiths of Ireland. A Folklore Sketch. By W. G. Woods-Martin, M.R.I.A. Vol. i., pp. xix + 405; vol. ii., pp. xv + 438. (London: Longmans and Co., 1902.) Price 30*s.* net.

"MANY readers may have read works treating of some one or more epochs included in the past of which Ireland has been the scene, but up to the present," says the author, "this lengthened period has not been treated as a whole." Such a complaint can no longer be made after the publication of this able and comprehensive work, which is, as its second title indicates, "A Handbook of Irish Pre-Christian Traditions."

The consideration of the main subject of the book, the faiths of Ireland, is preceded by about 120 pages of introductory matter concerning the geographical shape of the island, the Great Ice Age and the nature of the earliest inhabitants. Excellent illustrations are given of the effects of the Great Ice Age in moulding the sides of the hills, &c. In the enumeration of the various theories as to the causes of the Ice Age, a suggestion is made as to the significance of the sun being a variable star. This fact may possibly explain the whole mystery. Though not often mentioned by the theorists, namely by those who are in favour of Sir C. Lyell's geographical explanations or of Croll's astronomical arguments based on the variability in the shape of the earth's orbit, it cannot have been outside their views. If, for instance, it be true that, in the time of Ptolemy, α Geminorum (*Castor*) was the brighter, and, therefore, presumably the hotter, star than β (Pollux), we may suppose that the inhabitants of the planetary dependents of the former are now experiencing a glacial or those of the latter a torrid epoch.

Ireland seems to have been the home of the gigantic

deer, their increase being explained by the total absence of lions from the island.

The earliest inhabitants of the country migrated, it would seem, from the south-west of Scotland into Ulster. According to the author, the fact that the skulls of these early inhabitants are often rather larger than those of the average of the masses inhabiting the great cities of the present day is explained by the intelligence needed for defence and for the procuring of food.

"Indeed, on the principle of the survival of the fittest, it could only be the robust who lived through the hardships and climatic exposure incidental to a savage life."

The author, in his summary, admits the theory of evolution, though under the direction of the Great First Cause.

Even as late as the time of the Spanish Armada, the inhabitants of Ireland were described as follows by Captain Cuella, who escaped from one of the wrecks off the Irish coast:—

"They live in huts made of straw. The men have big bodies, their features and limbs are well made and they are as agile as deer. They eat but one meal a day, and their ordinary food is oaten bread and butter. They drink sour milk, as they have no other beverage, but no water, although it is the best in the world. They dress in tight breeches and goatskin jackets, cut short, but very big, and wear their hair down to their eyes."

It is not surprising that such a race should entertain the curious ideas so abundantly described in the author's pages.

Nowhere in Ireland has discovery as yet been made of any Palæolithic art like the extraordinary and life-like incised sketches of men and animals made by the cave-men of Gaul. No representations of human or animal forms seem to have been made prior to the introduction of Christianity. Even then, they were of an arabesque character and subsidiary to the scroll work in which they were entwined. Nor does iron appear to have been introduced into Ireland until the fourth century, A.D.

It is difficult to fix the point where real Irish history commences. An interesting map of Ireland according to Ptolemaic geography is reproduced on p. 230. There is said to have been no Roman colonisation, though Roman objects were, of course, imported. An illustration is given (p. 237) of a Roman medicine stamp of smooth grey slate found in the county Tipperary. It was probably used to stamp a "patent medicine" made and sold by the Romano-Hibernian dealer whose name it bears.

In the chapter which deals with stone worship, there seems to be so little, so far as Megalithic remains are concerned, which can be illustrated from Ireland that the chief example has to be drawn from Carnac, in Brittany. One circle of stones, indeed, is introduced, named the Druids' circle, near Killiney, which consists of seven small stones and two uprights large enough to be called *giants*. There are no data, however, given from which the age of the work, as in some of the Megalithic circles in Great Britain, could be investigated, and there is only one instance, and that a doubtful one, of anything of the nature of the alignments in Brittany which can also to some extent be interpreted astronomically; but there are numerous and very curious examples of perforated stones which have been employed even in comparatively recent times for passing children through in hopes of curing them from various disorders. These holes, in some instances, are large enough to allow grown-up people to creep through them, though generally with difficulty. Sometimes the holes were only large enough to admit the arm, or even the thumb and fingers, to be passed through them. Marriage contracts, it is said, are still ratified in this way, country couples signifying betrothal by clasping hands through the hole. Such practices, it is shown, were not confined to Ireland, but the evidences seem to be very greatly multiplied in that country. The history is given of the *Stone of Destiny*, as it was called, which is now placed under the Coronation Chair in Westminster Abbey. This supposed magic stone, which roared like a lion when a legitimate king stood upon it, was, it is alleged, sent to Scotland in the ninth century in order to secure the then dynasty on the throne. It was preserved with great care at Scone, in Perthshire, until 1296, when it was carried off by Edward I. of England.

Lovers of folklore will find in this book abundant illustrations of that subject, and among them many examples of prehistoric practices surviving into recent and even modern times.

MIGRATORY LOCUSTS.

Die Wanderheuschrecken und ihre Bekämpfung in unseren afrikanischen Kolonieen. Von Dr. L. Sander. Pp. 544. (Berlin: Reimer, 1902.) Price 9 marks.

AFRICA has always been exposed to the ravages of migratory locusts, the fringe of cultivation on the borders of extensive deserts or wildernesses being peculiarly favourable to their attacks; and this applies more especially to the north and south of the continent. Dr. Sander's volume is a carefully compiled account of their ravages in the German colonies of Africa during the last ten or twelve years, for though travellers and missionaries have left us accounts of earlier invasions, yet the first disastrous appearance of locusts in East Africa since the German occupation was in the years 1894 and 1895, when a serious famine was the result. A graphic account is given by a native of Pangani, from which we may extract and condense a few sentences:—

"In December there came vast swarms, so that the heavens were covered by them, as if with black clouds. The locusts have devoured everything in the country, especially lentils, peas and bananas. We are in a sad state here, for they have devoured the whole harvest, and it will take years to repair the damage. First we must dig over the whole country, for the locusts have devoured everything, root and branch. Second, we must buy fresh seed, and that will cost much money. Third, we must buy our food from the traders for the present, for we have nothing left to live upon. The locusts have been here in vast swarms since November and December, and have not yet retired. We have the black and yellow ones here, and red ones too. Our largest landowners and sugar manufacturers have removed to Pangani because their plantations lie wasted. Each of these gentlemen has hundreds of workmen to provide for. For the present, there is no thought of the retreat of the creatures. I tell you that when a swarm comes, we can often scarcely see the sun. The locusts

are greedy beyond expression. A European laid out some cotton and coffee to dry in the sun, and when he looked for it after a time the locusts had devoured it all —cotton, coffee, and even the blankets on which the raw material had been spread out." Since then, the locusts have never left the district, and were again very destructive in 1898 (pp. 7, 8).

In South-west Africa, various locust invasions are noticed, from 1831 to the present time; and it is recorded that at Barmen (in the present Orange Colony) in 1866, the

"Fussgänger" (immature locusts) "not only devour all the plants, green or dry, before them, but everything that they can find, including linen and clothes left unprotected; for they creep into the houses even to the bedrooms, and eat up everything" (p. 20).

A pitiful story comes from Little Namaqualand in 1873:—

"On the morning of May 5 I held a prayer-meeting to implore the Lord to send us a little rain, and to put an end to the great drought and distress. In the afternoon clouds actually rose, and we heard a rushing in the air as if it was about to rain; but, alas! the noise was caused by swarms of locusts, which covered the whole place, and completely devoured the little dry grass that was left" (pp. 21, 22).

One is forcibly reminded of the old story of the Adites, who sent a deputation to Mecca to pray for rain, and were answered by a black cloud which sent forth a desolating wind which exterminated the whole tribe.

After discussing the ravages of locusts in the various territories of German Africa, Dr. Sander proceeds to give a full account of the habits, transformations, biology, &c., of the most destructive species of African locusts, and also discusses the best means of contending with their ravages; and the natural enemies of locusts (birds, &c.) are also noticed. Without being overloaded with illustrations, there is a sufficiently good series in the text to render the subject intelligible to the general reader. An appendix contains an interesting edict of Frederick the Great, ordering the destruction of locusts in Prussia in 1753. Dr. Sander's maps illustrate the prevalence of the pest in German East Africa from 1897 to 1899, and in Cape Colony and South-western Africa from 1891 to 1900. His book, though written, of course, for the benefit of the German colonies in Africa, deserves the most serious attention from all who are interested in the welfare and prosperity of our own African possessions.

W. F. K.

OUR BOOK SHELF.

Applied Mechanics for Beginners. By J. Duncan, Wh.Ex., A.M.Inst.C.E., &c. Pp. x+324. (London: Macmillan and Co., Ltd., 1902.) Price 2*s.* 6*d.*

WITH the development of the mechanical laboratory in technical schools and colleges, the teaching of mechanics has in recent years undergone a quiet revolution. Experiments are no longer confined to the few made by the teacher, but the students now all take a share in this kind of work, which has become an important part of the school or college course, being of great value, as affording the training in inductive methods which in former times was often neglected.

The volume under review shows the influence of these prevailing conditions. A considerable portion of the book is devoted to the description of laboratory appliances, the methods of making tests and the kind of information to be got therefrom. Some of the apparatus is of quite a simple character, such as a student may readily make and use at home, and yet from which fundamental mechanical principles can be verified and illustrated in a satisfactory manner. In other cases, the experiments are more elaborate; those dealing with hydraulics strike us as being particularly good.

Another important part of a course in applied mechanics is the working of many numerical examples; here also the requirements are well met, and the student is amply provided with material in great variety. The answers to the examples are given at the end of the volume.

There are a few defects which may probably be remedied in great measure in a future edition. The diagrams are well drawn and clearly printed, but in some cases the letters of reference are unfortunately too small. The author is not very happy in his definitions of the engineer's units of mass and force, and occasionally his enunciations of fundamental principles of mechanics could be improved by revision. The treatment of vectors is rather weak. We should like to have seen more use made of the *radian* measure of angles and angular velocities in the many problems involving rotation.

These faults do not detract materially from the general merits of the book, which is one that can be confidently recommended for the use of students who are beginning the subject of applied mechanics and wish for guidance in obtaining an experimental knowledge of the foundations on which the science is built, and for an account of many of its applications in the arts.

Compte rendu du deuxième Congres international des Mathématiciens tenu à Paris, 6 au 12 Aout, 1900. Pp. 450. (Paris: Gauthier-Villars, 1902.)

AMONG the innumerable congresses held at the Paris Exhibition, this one dropped completely out of sight. On arrival at the advertised place of meeting in the Hall of Congress, it was found occupied already by some 1500 deaf-mutes, assembled in conclave; naturally they could give us no information. The Mathematical Congress was discovered at last, on the top floor of the Sorbonne, where it was left severely alone by the French professors, too dignified to meet the herd of visitors on equal terms.

The Physical Congress, held simultaneously, carried off all but the mere pure mathematicians, who enjoyed themselves by reading papers to each other on arithmetic and algebra, analysis and geometry, bibliography and teaching methods.

An eloquent address by M. Poincaré, the president, who put in an appearance at the closing ceremony, on the *rôle* of intuition and logic in mathematics, an extract from a lecture by Mittag-Leffler on a page of the life of Weierstrass, Hilbert's discourse on the mathematical problems of the future, and communications by M. Cantor on mathematical historiography and by Vito Volterra on Betti, Brioschi and Casorati, these form the most important part of the volume.

Wood: a Manual of the Natural History and Industrial Applications of the Timbers of Commerce. By G. S. Boulger. Pp. viii + 369. (London: Edward Arnold, 1902.) Price 7*s.* 6*d.* net.

THE contents of this ugly volume, of heavy paper and with narrow margins, are more worthy of attention than its exterior suggests, and comprise an immense amount of information about the timbers of commerce from many points of view. That it is a compilation which would probably never have seen the light had not the works of

Hartig, Nördlinger, Laslett and Marshall Ward preceded it may be a safe surmise, but the author has done his work much in his own way, and, on the whole, has done it well, and acknowledges his indebtedness to the above and to other writers. The longest section, that on the sources, characters and uses of the woods of commerce, which occupies more than two hundred pages of the three hundred and fifty composing the book, abounds in interesting facts about the foreign and colonial timbers now so largely imported into this country, though why the word "Acacia," on p. 141, is limited to "Robinia" and "Eucryphia" is the more puzzling since the author shows, on p. 341, that the wattles of Australia are the true plants of that genus.

The sections on the recognition and classification of woods, on seasoning, on the supplies of wood and on testing are also good; those on the origin, structure and development and on the defects of wood are less so. Indeed, the whole subject of the microscopic structural characters is very poorly treated, and the appendix on the microscopic examination of wood might as well have been omitted. This is a pity, since it is just in this direction that so much interesting and important work has been done of late, and the author's meagre treatment of this theme and his omission of any mention of the publications of Müller, Mer, Strasburger and other investigators suggest that he is here on unfamiliar ground. Moreover, certain slips, such as the confusion of the schlerenchyma of a peach stone with wood (p. 2), the denial of wood to the so-called herbaceous plants and the retention of the term "exogenous" (p. 3), the inadequate treatment of cellulose (p. 6), the denial of tracheæ to the protoxylem of Conifers (p. 19) and the explanation of the term "desmogen," are signs pointing to the same conclusion.

On the other hand, there are some capital photographic reproductions of the appearances of various woods in transverse sections, and the material is well arranged and rendered accessible by what appears to be a very complete index.

L'Eau dans l'Alimentation. By F. Malméjac. Pp. 312. (Paris: Felix Alcan, 1902.) Price 6 francs.

IT is quite true, as the author of this work states, that the great problems connected with the purification of water and its safety or danger when used for drinking purposes are not yet solved, but although he claims—and not without reason—that his work is something more than a compilation, inasmuch as it contains results of special study on the points which have appeared to him the least clear or the more controversial, the reader who has studied, say, the works by Thresh or Mason on the subject will find little to learn from the present volume.

The work is certainly a useful and interesting one, but it scarcely justifies the eulogistic preface written by M. F. Schlagdenhauffen, honorary director of the Higher School of Pharmacy of Nancy, from which the reader would conclude that the present volume was almost an epoch-making contribution to an important subject.

The book is divided into five parts, which are subdivided into chapters. The first part deals with water in general, including the microscopic, the chemical and the bacteriological examinations, and the other four parts deal with the organic matter of water, the germs of water, the filtering value of different earths and the purification of water.

Our Dogs' Birthday Book. Arranged by Mrs. F. H. Barnett. With Twelve Pictures of Champion Dogs. Pp. 144. (London: George Allen, 1902.)

A BIRTHDAY book of the familiar kind, except that the quotation under each day of the year is concerned with dogs.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Hydrographical Work of the North Sea Investigation Committee (Scotland).

IN weather of exceptional severity, Lieutenant and Commander Sharp, of H.M.S. *Jackal*, has just brought his second hydrographical cruise to a successful issue. The *Jackal* left Aberdeen on December 4, and followed approximately the same course (on lines laid down by Mr. H. N. Dickson) as on her autumn cruise in August-September (*cf.* NATURE, October 30, 1902), that is to say, northwards to Lerwick, thence in a north-easterly course to near the Norwegian coast, then westward to Faeroe and back along a somewhat more southerly track, passing between Shetland and Orkney and out into the North Sea as far as the meridian of 0°. The last observations were made on December 15. About 125 water-samples were obtained at various depths, in full series, at twenty stations, and surface samples were collected in addition hour by hour. Captain Sharp bore, on this occasion, the whole responsibility of collecting the samples and observing the temperatures, and I venture to think that, in spite of the worst possible weather, he has achieved remarkable success. The water-samples are being estimated in the laboratory of my colleague, Prof. Walker, and when this work is done, the whole of the data will be handed over to the hydrographers; but the temperature records are in themselves interesting, so much so that I think it right to publish them in the following brief abstract.

The stations were as follows (numbered according to those of the August cruise with which they approximately correspond:—ii., 58° 36′ N., 1° 46′ W.; iv., 59° 17′ N., 1° 30′ W.; vi., 60° 37′ N., 0° 30′ E.; vii., 61° 12′ N., 1° 52′ E.; viii., 61° 40′ N., 3° 4′ E.; ix., 61° 39′ N., 2° 0′ E.; x., 61° 38′ N., 0° 33′ E.; xi., 61° 50′ N., 1° 0′ W.; xii., 61° 0′ N., 1° 18′ W.; xiii., 61° 10′ N., 2° 9′ W.; xiv., 61° 23′ N., 3° 25′ W.; xv., 61° 38′ N., 4° 39′ W.; xvi., 61° 44′ N., 6° 3′ W.; xvii., 61° 13′ N., 6° 34′ W.; xviii., 60° 53′ N., 5° 30′ W.; xix., 60° 35′ N., 4° 26′ W.; xx., 60° 13′ N., 3° 9′ W.; xxi., 59° 40′ N., 1° 15′ W.; xxii., 59° 32′ N., 0° 2′ E.; xxiv., 58° 53′ N., 0° 25′ W.

To take first the surface-temperatures. These fluctuated much in the first part of the course from the entrance of the Moray Firth to Lerwick. Starting at 7°·5, the temperature rose opposite the Pentland Firth to 8°·8, fell off the Orkneys to 6°·6, rose again in the neighbourhood of Fair Isle to 9°·3, and after falling as low as 5°·4, rose to 8°·4 at Lerwick. Similar temperatures (8°·3–8°·5) were then met with as far as Station vii., after which point there was a rapid rise to 9°·6, followed by an exceedingly sudden drop to 6°·6 (the salinity dropping from about 35°·3 to 32°·6) near Station viii., off the Norwegian coast. Running westward, temperatures ranged in the neighbourhood of 9°·5 all the way to the middle of the Faeroe Channel, and then dropped between Stations xiv. and xv. to 7° at the latter point. They rose again as Faeroe was approached, to 8° or a little less; and on the homeward and more southerly course, a colder current was again crossed, this time in a broader and apparently double belt, between 4° and 5° W. longitude, with temperatures of 6°·6 to 6°·8. Eastward of 4° W., a rapid rise took place to 8°·9, rising further to 9°·4 a little to the east of 3°, and thereafter the curve fell, with considerable fluctuations, to about 8° at the limit of Station xxii. (0° 2″ E.).

Passing to the deep-water temperatures, we have, on the line from the Moray Firth to Lerwick (Stations ii., iv. and xxi.), everywhere warmer underlying colder water, the readings at 0 and 100 metres being respectively 8°·2–8°·8, 8°·8–9° and 8°–8°·6.

Between Lerwick and the coast of Norway, we have firstly at Station vi. slightly irregular readings, falling from 8°·5 at the surface to 8°·2 at 130 m.; at Station vii., the surface-water of 8°·3 has underneath it warmer water to 8°·85 at 60 m., cooling to 8°·65 at 140 m.; while at Station viii., a broad zone of similarly warm water underlies the very cold (6°·7) surface-layer (6°·05 at 20 m.), giving us readings of 8°·3 at 100 m., 8°·7 at 200 m., below which level the temperature falls again to 6°·0, at 380 m., near the bottom. Turning westward, we have at Station ix.

practically the warmer waters of Station viii., released from the superincumbent colder layer; that is to say, we have at 20 m. 8°·6, at 100 m. 8°·4, at 200 m. 7°·85 and at 300 m. 6°·91. At Stations x. and xi., the water cools very slowly downwards, from 9°·6 to 8°·8 at 170 m. and from 9°·3 to 7°·8 at 360 m., respectively. At Station xii., in shallower water, we have readings to 100 m., practically identical with those to the same depth at Station xi., further to the north.

The records along the next two lines, those crossing the Faeroe Channel, deserve to be given in detail.

Faeroe to Shetland (xvi.–xii.)

Depth in Metres.	xvi.	xv.	xiv.	xiii.	xii.
	°	°	°	°	°
Surface.	7·9	7·5	9·5	9·5	9·2
100	7·6	7·45	8·8	8·9	8·9
200		7·51	7·72	8·9	
300		6·81	7·6	8·9	
400		3·2	5·56	8·7	
500		1·38	2·12	7·9	
600		0·4	0·34	(at 460	
700		−0·2	−0·25	metres.)	
800		−0·48	−0·45		
900		−0·65	−0·65		
1000			−0·7		
1100			−0·8		

Ditto (*Southerly Course*) *and on by Fair Isle to* 0° 2″ *E.*

Depth.	xvii.	xviii.	xix.	xx.	xxi.	xxii.
	°	°	°	°	°	°
Surface.	8·0	7·6	6·9	9·3	8·0	8·2
100	7·9	7·53	7·69	9·9	8·6	7·54
200	(80 m.)	7·55	6·8	9·0 (at		
300		7·59	4·28	150 m.)		
400		6·9	0·5			
500		1·62	−0·25			
600		1·72				

The first of these two tables corresponds as closely as possible with that given by Mr. Helland-Hansen for the August cruise in the note to NATURE already quoted. The most striking differences will be found to be that below 300 metres the temperature is now much higher at Station xiv., and at 400 m. it is now much lower at the more westerly Station xv. This means that the cold wedge is now considerably further to the westward and probably also of less vertical extent. In the more southerly section (Table II.), the cold wedge is seen, of great intensity, at Station xix. It is to be regretted that the next station (xx.) to the eastward of xix. is a shallow-water one, and still more to be regretted that we have no deep-water station to the westward of Station xv.

I have hastened to publish these few preliminary notes in the belief that many are interested in the progress of the work, and because we shall have long to wait until the full data are available and the final deductions are drawn by competent hands.

D'ARCY W. THOMPSON.

Dundee, December 29, 1902.

The Quadrantids of 1903.

OBSERVATIONS were made at Hampstead Heath on January 1, 3 and 4 for the Quadrantid meteors. During a combined watch of six hours, 57 meteors were seen, distributed thus:—

		h. m. h.		
Jan. 1	...	11 55 to 14	...	18 meteors
3	...	14 0 to 16	...	29 ,,
4	...	15 0 to 17	...	10 ,,
		Total	...	57

The paths of 10 only were registered, which I append as follows:—

Date.	Time.	From R.A.	From Decl.	To R.A.	To Decl.	Mag.	Remarks.
	h. m.	°	°	°	°		
Jan. 1	12 5	210	+50	130	+40	2	Sl. stk.
,,	12 21	240	+45	247	+35	1	,, ,,
,,	12 39	217·5	+43	185	+30	2	Sw. stk.
,,	1 10	211	+29	195	+10	2	Sl. stk.
,, 3	14 5	197	+33	182	+23	1	,, ,,
,,	14 16	195	+40	165	+30	1	,, ,,
,,	14 33	225	+50	226	+51[1]	3	Sl. streakless.
,, 4	15 59	215	+49	170	+43	1	Sl. stk.
,,	16 7	220	+27	213	+15	2	,, ,,
,,	16 14	196	+30	150	+ 9	1	Sw. stk.

Sl. = slow, Stk. = streak, Sw. = swift.

25 Holford Square, Percy Circus, W.C., January 11.

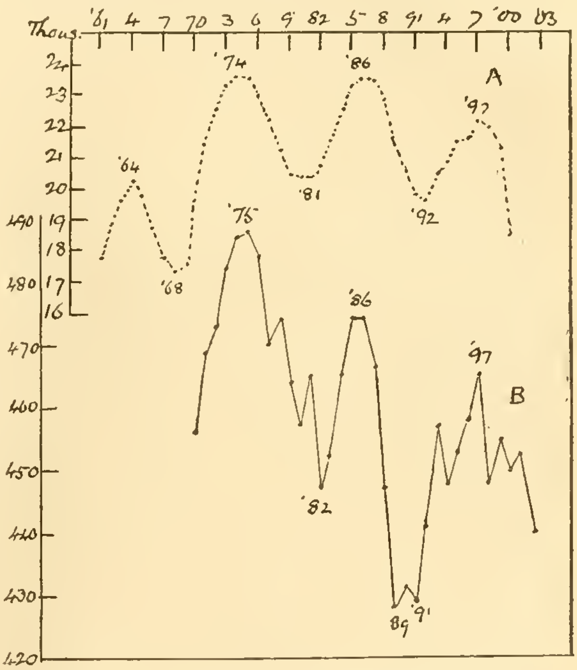
G. MCKENZIE KNIGHT.

[1] A short pathed meteor.

Sun-spots and Summer Heat.

Is not a connection between these rather distinctly suggested by the enclosed curves?

A is obtained from sums of the sun-spot figures (mean daily area) in the thirty years ending 1861, '62, '63, &c.



B is from sums of the number of days with maximum temperature over 80° in the thirty years ending 1870, '71, '72, &c.

ALEX. B. MACDOWALL.

4 Bodfor Terrace, Aberdovey, Wales, January 5.

A Curious Projectile Force.

HAVE you or any of your readers had an experience similar to this? I placed a half bottle of champagne, *half full*, in a basin in a lavatory, with cold water tap dripping in same, corked. About twenty-four hours later we heard a crash, and found that the bottle had literally jumped out of the basin through the window and out into the garden, breaking itself on the stone work beneath window. Now I know there would be nothing remarkable in a bottle bursting, but in this case not a particle of glass was found in the room, and the hole in the window-pane being so clean cut shows enormous velocity. The wine was a good brand and of the year 1892. A scientific friend tells me the facts are so unaccountable that I thought I would venture to trespass on your space.

B.A. OXON.

THE HEWITT MERCURY LAMP AND STATIC CONVERTER.

ONE of those happy discoveries which at once and unexpectedly supply the solution of a difficult or hopeless problem was brought to the notice of a limited number of railway and of scientific men last Friday evening by Mr. George Westinghouse. The company were invited to meet Mr. Westinghouse at the Westinghouse Company's office in Norfolk Street, Strand, to see two of the inventions of Mr. Peter Cooper Hewitt, of New York, and to meet again at Claridge's Hotel, after an hour, in circumstances that would enable them more easily to contemplate the full beauty of what they had seen.

The mercury vapour lamp consists of a long vacuum tube, perhaps a yard long and an inch in diameter, but of dimensions depending on the current and potential available and the light required, with an electrode at each end, but at the lower end, which is the negative pole, the tube is blown out into a bulb, which contains a quantity of mercury. When the ordinary voltage of a house supply is applied to the terminals, nothing happens at all, as it is not sufficient to break across the long, vacuous gap. If, however, a single spark from an induction coil is sent from one terminal to the other, the current from the house mains is immediately started and continues to pass indefinitely, producing a brilliant light absolutely without flicker, but of a ghastly hue. It is a splendid and economical light, requiring, according to the information furnished, only half a watt, or under favourable conditions only one-third of a watt, to the spherical candle-power, whereas ordinary incandescent lamps require about four watts to the candle-power. It is a beautiful light to work by so long as colour is not a point—for instance, for engineers' drawing or for lathe and machine-shop work—as the extent of the luminous surface does away with the glare and the contrast of sharp shadows cast by lamps of small surface. It is, no doubt, valuable for lots of things, and there is nothing to wear out. But the colour! It is not like the sodium light, practically monochromatic, so that all colour difference is abolished and everything becomes black or yellow or something between the two. That is merely hideous. Here, however, there is plenty of colour. The spectrum shows two bright orange lines, a green line, a pale greenish-blue line and a dazzling blue line, but no red. The result is that flowers and coloured articles appear wonderfully coloured, but not with their own natural colours, and what any pigment will look like no one can tell, nor can the faintest idea be formed of what the colour of anything seen by the light of the Hewitt lamp really is. The light plays such pranks with colour that the colour sense seems to have gone crazy. One red thing will appear blue, another black, one blue thing blue, another brown, but the skin becomes ghastly. If anyone sees himself in a glass, it is difficult for him not to form a sort of opinion that he is killed and drowned and dead as well. These effects the Westinghouse people believe may somewhat interfere with the success of the lamp as a domestic luminary. But even here there are possibilities. A wisp of silk dyed with a particular crimson dye appears to have its colour enhanced. It shines with a glorious luminosity among its surroundings, on which not a trace of a rosy tone can be discovered. This is a true fluorescence. If a spectroscope be turned on the lamp or any ordinary thing lighted by it, the red end of the spectrum is absent, but when this particular dye is brought up, the whole of the red end flashes out, and other things may be seen more as they are. A striking experiment is to look at the lamp through ruby glass, through which hardly any light can be detected, and then to bring up the dyed silk, which immediately appears to create its own light and shine brilliantly.

Enough has now been said to give an idea of the Hewitt lamp, which is found to have the remarkable property, one not unknown as a vacuum phenomenon, of only allowing a current to pass in one direction, that being with the mercury as a negative pole. If it is attempted to send a common alternating current through a Hewitt lamp, it may be started by a preliminary spark, but at the first reversal it goes out, and so it has to be started perhaps a hundred times a second to keep it going. If, however, the three ends of a star-wound triphase transformer or generator are connected with three electrodes near the top of a globe and the common centre is connected with the mercury pole at the bottom, then, as before, nothing will happen until a starting spark has been sent across the globe, for which purpose a fifth electrode is placed at the top; then at once the triphase current starts running round from electrode to electrode, and always going to the mercury below, and each current being still alive when the next is ready to start, they keep each other going and a single direct current leaves the mercury electrode. By this simple means, it is possible to rectify a current of even 1000 volts, subject, however, to a constant loss of 14 volts in the bulb, and this whatever the voltage. As the contrivance will work with anything between 100 and 1000 volts, and at present up to 100 amperes, it will be evident that if further experience bears out the information so far available, the present methods of conversion depending on the use of rotary converters and motor generators will be at an end, and the labours and ingenuity of Mr. Pollak and others with the aluminium cell largely superseded. With the higher voltage, the economy is unapproached by other methods, the loss being only 1·4 per cent., which appears as heat in the bulb.

C. V. B

THE VIBRATIONS OF GUN BARRELS.

A SERIES of experiments has been conducted by Messrs. C. Cranz and K. R. Koch for the purpose of obtaining information respecting the character of the vibrations set up in the barrel when a gun is fired. It is a matter of experience that when a cylindrical rod is struck by an approximately axial blow, the particles of the rod, instead of vibrating in straight lines, perform in general elliptic vibrations the axes of which vary in direction at different points, and it was one of the objects of the investigation to ascertain how far a gun barrel behaved in the same manner.

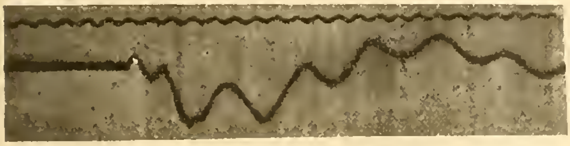
For this purpose, a number of military rifles supplied by the firm of Mauser were furnished with projecting wires the motions of the shadows of which, thrown on a screen by a powerful lens, were recorded by photography, a tuning-fork similarly projected affording a standard of comparison from which the period of vibration could be measured.

The rifles were either fixed in a support of cork or held in the position usually adopted by marksmen, under conditions closely resembling those existing in actual rifle practice. By means of an electric spark, a mark was recorded on the photographic plate indicating the exact instant at which the projectile left the barrel.

An example of the diagrams obtained is shown by Fig. 1 for a rifle fixed in cork and by Fig. 2 for free firing. It will be observed that under the latter conditions a dark shadow is in general produced by the recoil of the rifle, and it is only possible to study such parts of the vibration curves as are not blotted out by this shadow.

The experiments show that the vibrations are in general, as predicted, elliptic in character, each vibrating particle describing a small ellipse instead of a straight line. The vibrations are generally similar to those of an elastic rod fixed at one end, and consist of a fundamental tone and overtones, of which as many as three have been

observed. From the tabulated results, it appears that the periods of vibration for the fundamental and first two overtones, while varying considerably for different rifles, may be said to be roughly about 0·04, 0·008 and 0·002 of a second, and the first two overtones are those the periods of which have been the most completely determined. In the case of the other vibrations, most of the tabulated results contain the mere indication that they have been observed, from which it is a natural inference of the reader that they have been much less intense, a result

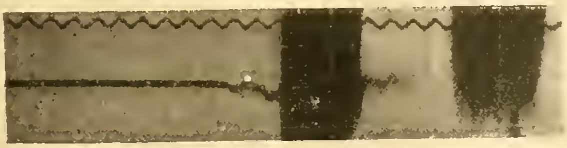


γ

FIG. 1.—10-Millimetre Servian rifle, right-handed breech, fixed in cork.

which appears on general grounds highly probable. The nodal points of the overtone appear to a certain extent to vary periodically in position. The vertex of the angle of vibration, instead of being at the screw of the breech pin, as commonly assumed, is at a nodal point near the muzzle, a result arising from the effect of one of the overtones at the instant when the bullet leaves the gun, and as the overtones predominate, the vertex approaches the muzzle.

Of practical interest is the conclusion that, since a certain time elapses before the vibrations are completely

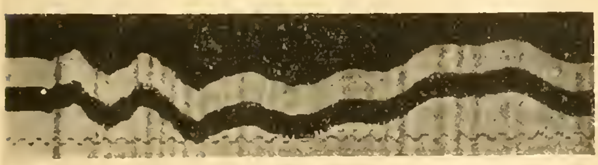


γ

FIG. 2.—11-Millimetre Mauser held as in rifle practice. The white spot γ, indicates the instant of the bullet leaving the barrel.

formed, it is important that the bullet should leave the muzzle before the deflection of the barrel has become considerable, and hence that a small-bore gun is to be preferred to one of large calibre. In the six-millimetre Mauser gun, it would appear, from the position of the white dot in Fig. 3, that the limit in this direction has practically been attained, so far as horizontal vibrations are concerned.

Two further points are discussed. The effect of the breech has been observed by comparing guns with a right-handed and left-handed breech respectively. In



γ

FIG. 3.—6-Millimetre Mauser rifle, fixed in cork.

the former, a deviation to the right of 7mm. per 4·5 metres was observed, in the latter, a deviation to the left of 4 mm. in the same distance.

The other question arises in connection with the attachment of bayonets. In some observations of the horizontal vibrations, a rifle of 11 mm. calibre was experimented on, with the bayonet attached at one side, the lateral attachment being the best calculated to affect these particular vibrations. The effect was to increase the periods of the first overtone from 0·0095 to 0·0130 of a second and of the second from 0·0016 to 0·0036 of a second, to give rise to a third overtone of period 0·0011 of a second and also to alter the phase at the instant at which the bullet left the muzzle.

The paper of which this is a brief summary is published in the *Abhandlungen* of the Bavarian Academy (cl. 2, vol. xxi. part iii., pp. 559–574), and it will be seen that it has an important bearing on rifle shooting generally. A marksman who is fully aware of the nature of the vibrations occurring in his rifle ought to be able to allow for them, with a little practice, far better than one ignorant of the scientific aspect of the question.

G. H. BRYAN.

PROF. JOHN YOUNG.

JOHN YOUNG was born in Edinburgh in 1835. He was educated at the High School and at the University, and finally he graduated as doctor of medicine. Like many of his time, he came under the spell of the great teachers who then made the northern university famous, such men as Goodsir, Edward Forbes, Christison, Syme and Simpson, and there is reason to believe that in particular the first two gave a scientific bias to Dr. Young's career. For some time he worked on the staff of the Ordnance Survey and made a friend of Sir Roderick Murchison, then a leader in the geological world. This was followed by his appointment to the chair of natural history in the University of Glasgow in 1866, and in this chair he taught both zoology and geology for nearly thirty-five years. After a period of failing health, he died on December 13, 1902. Such, in brief, is an outline of his career, but those who knew Dr. Young will recognise how imperfect a representation it is of the man's personality. Gifted with a keen and penetrating intellect and a fertile imagination, showing versatility of acquirements rarely met with, absolutely unconventional, he was also a man of untiring and restless energy. He was a scholar in a high sense of the term, he possessed a cultivated and pure literary taste, he was an artist facile both with brush and pencil, and he had a wide and critical taste in music. As keeper of the Hunterian Museum, he acquired much knowledge of rare books and manuscripts, of the great collection of coins and medals to be found there, and of works of art. Wide, however, as was the sphere of his activity in the University, he yet found time for active labours in the cause of female education, in the work of the Technical College, and in the municipal and social life of the city of Glasgow. It was this versatility and superabundant energy that hindered Dr. Young from doing the amount of original work in the two sciences of zoology and geology which might have been expected from a man of his genius, and the work of his life must not be judged from this point of view. His chief labour, perhaps, was the systematic arrangement of the great legacy of William Hunter—books, pictures, medals, engravings, coins—and in this work he took a keen delight and over it he spent laborious hours, even far on into the night when silence reigned in the cloisters. But it was the man's individuality of character that made him a force in his time. Often a determined opponent, he could also be a true friend, while his mental moods, sometimes quiet and observant, ofttimes brilliant and radiant with flashes of wit and humour, constrained even those who knew him best to regard him as a man quite by himself. He has thus left little of an enduring character in the literature of science, but he will be long remembered by many generations of students in the University of Glasgow.

JOHN G. MCKENDRICK.

JAMES WIMSHURST, F.R.S.

WE regret to have to announce the death of Mr. James Wimshurst, F.R.S., which occurred at his residence on Saturday, January 3. Mr. Wimshurst was born in London in 1832 and was therefore in his seventy-first year. He was for a long time a surveyor with Lloyds', both in London and in Liverpool, finally becoming principal shipwright surveyor to the Board of Trade, which appointment he held until a few years ago, when he retired under the age rule.

Mr. Wimshurst was devoted to scientific pursuits, in which he spent the greater part of his spare time. At his private house at Clapham, he had a laboratory and workshop, which he had himself fitted up with the assistance of his two sons. It was here that he worked out the new designs in influence machines which have made his name familiar to every student of science. His attention was first turned to this subject about 1881, when he constructed a machine of the Holtz pattern, but embodying several important improvements. After about a year's work, he designed an influence machine with oppositely rotating glass discs bearing metal sectors on their outer faces, which he called a "duplex" machine, but which has been universally known since as "Wimshurst's machine." For many years, he continued perfecting this pattern of electrostatic generator, building larger and more efficient machines. These machines have displaced all other generators of static electricity on account of their possessing the property of being self-exciting under any atmospheric conditions; they are very largely used for experimental, X-ray and electromedical works.

In 1890, Mr. Wimshurst designed a machine capable of producing rapidly alternating charges of electricity. In the same year, he was elected a member of the council of the Physical Society. In 1898, he was elected a fellow of the Royal Society; he was in addition a member of many other scientific societies, including the Institution of Electrical Engineers and the Röntgen Society; he was also a member of the board of managers of the Royal Institution.

All Mr. Wimshurst's scientific research was done for pure love of the work, and he persistently refused to accept any pecuniary benefit from it. His advice and assistance were always at the service of those interested, and his long experience with influence machines made his advice invaluable and in frequent requisition.

NOTES.

WE are authorised by Prof. J. J. Thomson to contradict the announcement that he has accepted the chair of physics in Columbia University, U.S.A.

THE Geological Society of London will this year award its medals and prize funds as follows:—Wollaston medal to Prof. Heinrich Rosenbusch, of Heidelberg, Murchison medal to Dr. C. Calloway, Lyell medal to Mr. F. W. Rudler, Bigsby medal to Dr. H. M. Ami, of Ottawa, Prestwich medal to the Right Hon. Lord Avebury, Wollaston fund to Mr. L. L. Belinfante, Murchison fund to Mrs. Gray, and Lyell fund to Mr. George Edward Dibley and Mr. S. S. Buckman.

IN a letter to Wednesday's *Times*, Sir Norman Lockyer states that several months ago he discussed with Mr. Shaw, the secretary of the Meteorological Council, the desirability of obtaining information regarding barometric pressures from ships crossing the Atlantic, by utilising wireless telegraphy. It now seems probable that this idea will soon be practically realised, for in reply to an ethergram from Mr. Marconi, Sir Norman Lockyer asked for help in this matter, and on January 13 received the following message:—"By wireless telegraphy.—Thanks for suggestion, hope to be able to do so soon, big westerly gale here Monday.—MARCONI." Sir Norman remarks that all friends of Science will be grateful to Mr. Marconi for such generous and invaluable assistance which will undoubtedly be of enormous advantage to British meteorology.

THE article by Dr. J. C. McVail in another part of this issue (p. 254) directs attention to the present unsatisfactory position of the law relating to vaccination in England, and the need for educating and organising public opinion in support of a new Vaccination Act. At the end of the present year, the Vaccination Act of 1898 will have run its experimental course of five years, and the opportunity should then be taken to ensure the introduction of a new measure based upon scientific principles. It is to render assistance in this direction that the Imperial Vaccination League has been formed. A deputation of the League is to wait upon the President of the Local Government Board this week, and will place before him the principal points upon which legislation is needed in connection with vaccination, with particular reference to revaccination. Three sub-committees appointed recently by the League have reported upon the degree of immunity given by primary vaccination, the need for revaccination at the age of twelve years, the transfer of vaccination administration from Boards of Guardians to some authority charged with public health functions, and the preparation and supply of calf lymph. The deputation which will wait upon Mr. Long will doubtless refer to the conclusions of the sub-committees and will urge emphatically that legislation should tend in the direction suggested by them.

WE regret to announce the death of the Rev. Dr. H. W. Watson, F.R.S., author of standard works on mathematical and physical subjects, and of well-known treatises on the kinetic theory of gases.

WE notice with regret the announcement of the death of Dr. H. E. Schunck, F.R.S., distinguished by his researches in connection with the chemistry of colouring matters.

THE death is announced of M. Albert Hénocque, vice-president of the Paris Biological Society and assistant director of the laboratory of biological physics in the Collège de France. M. Hénocque was known for his work in connection with the spectroscopic examination of blood.

THE King of Sweden and Norway has, *La Nature* reports, conferred the Norwegian medal Til Beleenning (Pour le mérite) upon M. Berthelot in recognition of the work of the distinguished French chemist.

A REUTER telegram from Ashkabad states that a fresh earthquake occurred at Andijan at 11 a.m. on January 7. The shock was of a particularly violent character.

THE Royal Statistical Society has awarded a Guy medal in silver to Mr. R. H. Hooker, for his paper on the suspension of the Berlin Produce Exchange and its effect on corn prices, which was read before the Society on December 17, 1901.

LAFFAN'S AGENCY announces from New York that Mr. Henry Phipps has just given 250,000*l.* for the establishment of a hospital at Philadelphia for the study, treatment and prevention of tuberculosis. The Pasteur Institute in Paris will be the model for the new establishment, which, however, is to devote itself exclusively to tuberculosis.

AN International Fire Prevention Congress will be held in London on July 7–10 in connection with the International Fire Exhibition at Earl's Court.

THE *Times* correspondent at St. Johns reports that Lieutenant Peary has decided to make another attempt to reach the North Pole. He is looking for a suitable steamer for a voyage next summer.

A GENERAL exhibition, devoted to hygienic milk supply in all its branches, will be held at Hamburg on May 2–10, 1903. Applications by intending exhibitors should be made, not later than February 15, to the Geschafftstelle, 46, Kampstrasse, Hamburg.

THE Carnegie Institution has, says *Science*, granted 1600 dollars to Prof. E. W. Scripture, of Yale University, for the prosecution of researches on the voice; 5000 dollars to Prof. W. O. Atwater, for his work with the respiration calorimeter, and has also made grants, the amount of which is not reported, to the Peabody Museum of Yale University, and to send Dr. H. S. Conrad, of the University of Pennsylvania, to Europe to study varieties of the water-lily.

AN exhibition is being held in London of the results of what is described as a new process for the preservation of animal tissues, by the injection of a fluid, the composition of which is not made public. The process is said to afford a satisfactory method of embalming animal bodies and of preserving museum specimens in a condition closely resembling life. The period which has elapsed since the application of the process to the various preparations exhibited is said by the inventor to range from a few weeks to thirty years.

A WRITER in the *Times* of January 7 suggests that wireless telegraphy should be used for sending time-signals from Greenwich and other places at definite instants, so that they could provide a means of determining longitude on ships having instruments capable of detecting the signals, or for regulating clocks or chronometers. The same suggestion was made by Mr. John Munro in NATURE of August 28, 1902 (vol. lxvi. p. 416), and the idea has doubtless occurred to others. Another writer, in Saturday's *Times*, suggests that some steamers crossing the Atlantic should be equipped with instruments for sending wireless messages as to meteorological conditions in mid-ocean, so as to provide material for weather forecasts and warnings.

REUTER'S AGENCY announces that the British and German Governments have decided on the immediate dispatch to West Africa of a mixed commission to demarcate the boundaries laid down by the Anglo-German Agreement of 1893. The frontier which is now to be fixed is that from the southern shore of Lake Chad to Yola, a distance of some 300 miles. The commissioners will proceed up the Benue direct to Yola, where they hope to arrive by the end of March, and will then work their way along the frontier to Lake Chad and, after fixing the position of Kuka, will return by the same route. The work is expected to occupy about a year.

WE learn from the *Lancet* that Dr. Michael Grabham, of Jamaica, a zealous exponent of the West Indian Culicidæ, is at work upon the mosquitoes of the Atlantic islands and has already obtained interesting results. The Azores have yielded no specific forms of any interest, but from the Madeiras he has sent to the British Museum four or five new varieties of culex in addition to one or two already well known and described. Dr. Grabham has found at Teneriffe, on the south side, a small anopheles identical with, or allied to, the malarial insect of the west coast of Africa. He has found also the same mosquito as is concerned in the spread of yellow fever at Havana.

N a letter from Dr. Logan Taylor, the leader of the Sierra Leone expedition of the Liverpool School of Tropical Medicine, reference is made to the progress of the expedition in Sierra Leone. A very decided absence of anopheles larvæ in places where it was formerly easy to get any number has been noticed, and is due to their not being able to breed owing to the pools being either swept out or oiled regularly. Compared with the corresponding time last year, in some of the notoriously bad streets, where in a single house as many as six, seven or a dozen anopheles mosquitoes could be found in the early morning, this year, after searching house after house with great difficulty, one, or perhaps two, adult insects alone were discovered. Since the members of the Liverpool School expedition stopped clearing up yards and emptying out the water containing culex larvæ, no one else has taken up the work, and these insects are getting bad again, and unless the Government or the school will keep on the work, the money the school has spent on it will be almost thrown away.

THE copy of Sowerby's "English Botany" Supplement in the library of the Royal Botanic Gardens, Kew, is incomplete, wanting plates 2912 to 2960, with letterpress and index, also plates, with letterpress, 2964, 2977, 2978, 2983, 2987, 2988 to 2999. The director appeals to the public to assist him in completing this classical work on British botany, either by presentation or sale.

A NEWLY issued part of the "Conspectus Faunæ Grönlandicæ," which is now being prepared by the naturalists of Copenhagen, relates to the mammals, and has been written by Mr. Herluf Winge. The known mammals of Greenland are stated to be thirty in number, but sixteen of these are Cetaceans. On land there are two rodents (the polar hare and the lemming) and two ungulates (the reindeer and the musk-ox) found in Greenland, but the remaining ten are all Carnivores, of which four only are terrestrial and six are marine, *i.e.* seals. The four terrestrial mammals are the Arctic fox, the wolf, the polar bear and the stoat or ermine.

IN the *Sitzungsberichte der niederrheinischen Gesellschaft* (Bonn), Herr Constantin Koenen discusses the age of the human remains of the Neanderthal. The first of these, known as "Homo neanderthalensis I.," is referred to the second epoch of the Quaternary Palæolithic period, or "Moustèr's epoch," and the second form, "Homo neanderthalensis II.," to a somewhat later period.

MR. LOUIS BEVIER'S paper on the vowel I (as in pique), forming one of a series of papers on the various vowel sounds in the *Physical Review*, leads to the conclusion that the sound of I is characterised by a powerfully reinforced upper partial at some pitch generally lying between 1900 and 2500, usually nearest the value 2560, a chord tone which is generally present with a much larger amplitude than for the more open vowels, and beyond these two tones comparatively little intermediate resonance. The latter peculiarity seems to give the vowel its peculiar thin tone. It appears that the American I is more open than the German, and its characteristic upper partial lower pitched. The author proposes to present, in the course of time, similar studies on the labio-guttural vowels from A to U.

IN the Cracow *Bulletin*, No. 8, Dr. Ladislaus Natanson discusses from a mathematical standpoint the problem of the deformation of a thin cylindrical disc of plastico-viscous material under the action of normal pressure on its opposite faces. The investigation bears directly on Von Obermeyer's experiments. In connection with the question as to how far a plastic solid is representable as a viscous fluid, an interesting idea is introduced. If we imagine it possible for the pressure on the disc to be varied in such a way as to maintain the disc of constant thickness, then, according to the theory considered by Dr. Natanson, the pressure would be an exponential function of the time, the modulus of decay and therefore also the time of relaxation being finite. For a viscous liquid, on the other hand, the time of relaxation vanishes. From experiments such as those of Von Obermeyer, Dr. Natanson considers it possible to determine both the "coefficient of internal friction" and the time of relaxation.

IN the third part of the *Beitrage zur Psychologie und Philosophie*, Dr. Götz Martius gives a detailed investigation on the duration of light sensations. It is pointed out that "Talbot's Law," while defining the limits within which intermittent sources of light give rise to a uniform light-sensation of mean intensity, gives no information as to the actual duration of the light-sensation itself. Dr. Martius, after describing an apparatus used by Prof. Exner, gives an account by Karl Minnemann of a new light interrupter. It appears that the time which elapses before the sensation is a maximum depends on the intensity of the stimulus, decreasing in general as the intensity increases, while the duration of the sensation depends both on the intensity and on the duration of the stimulus. A discussion of the bearing of the actual results on kindred investigations such as those of Charpentier and Shelford Bidwell is noteworthy.

A SOMEWHAT remarkable attempt to trace points in common between such apparently different subjects as biology and education is made by Prof. Leopoldo Maggi, writing in the Lombardy *Rendiconti* in a paper entitled "Tachygenesis and University Studies." Both in the vegetable and animal kingdoms, it is pointed out that in the transition from the lower to the higher forms there is a continuous acceleration in the development of maturity, and this law of embryonic acceleration, which, following E. Perrier, the author describes as Tachygenesis, is an inevitable consequence of the struggle for existence. The same laws may be applied to social life, and it is suggested that they tend to bring about a reduction of the time given to university study in the lifetime of a man, but against this tendency there is the at present insuperable barrier opposed by regulations which fix the number of years required to complete the university courses. The new university regulations in Italy have reduced the minimum number of lectures in any course from about seventy to fifty, and this the author considers a good reason for reducing the length of the qualifying period for the university degrees. Prof. Maggi suggests several other applications of biological principles to allied social problems.

AN interesting article on the transmission of vision to a distance by electricity is contributed by Lieut. J. H. Coblyn to *L'Éclairage Électrique* for December 27. The author reviews briefly the theoretical aspect of the subject and the attempts which have been made at its practical solution. He suggests that some less sluggish transmitter than a selenium cell may have to be sought before satisfactory results are obtained, and as receiver proposes the use of a Blondel oscillograph, the moving part consisting of a tube which, as it is deflected, cuts off more or less of the light from a source of constant intensity. This is a modification of the method of Ayrton and Perry; another method proposed by M. Weiller is to use a sensitive flame the intensity of which is varied by a telephone diaphragm actuated by the transmitted current. In addition to the problem of reproducing the intensity of the illumination, a satisfactory solution has to be found to the difficulty of exploring the object and image synchronously at transmitting and receiving stations as the whole surface has to be covered in less than one-tenth of a second, the time of duration of the retinal impression. The author concludes that the problem is still surrounded with great difficulties.

Symons's Meteorological Magazine for December last contains a climatological table for the British Empire for 1901, so far as it can be shown by nineteen representative stations, but it is not claimed that the records quoted furnish more than a few useful samples of the various climates included in the British dominions. The highest temperature in the shade was 110° at Adelaide, in February. A new station has been included, viz. Dawson, where a temperature of −50° in the shade was recorded in December, but the observations are incomplete. The highest mean temperature was 82°·1 at Colombo, and the lowest 36°·4 at Winnipeg. The driest station was Adelaide, mean humidity 59°, and the dampest Colombo, mean humidity 82°. The highest temperature in the sun was 168°, at Trinidad. The greatest rainfall was 114 inches, at Lagos, and the least 18 inches, at Adelaide. None of the extremes referred to can claim distinction as "records," but at individual stations the sun temperatures at London, 139°·8, and at Malta, 162°·9, are the highest observed there, and at London the number of rainy days, 128, is the lowest since these interesting tables were commenced.

THE latest issues of the *Bulletin* of the Entomological Division of the U.S. Department of Agriculture include the *Proceedings* of the fourteenth annual meeting of the Association of Economic Entomologists and some miscellaneous results of the work of the division. In the former, attention is called to the magnitude of the injuries inflicted by insects on the forests and forest-products of the United States, and the crude condition of our knowledge relating to the life-history of the insects in question. It is urged, therefore, that the work of the division is one of great and increasing importance.

THE first part of vol. vii. of the *Anales* of the National Museum of Buenos Aires contains a memoir, with portrait, of the late Dr. C. Berg by Señor A. Gallardo. In the same issue, Señor A. Mercerat describes a very imperfect skull of a toxodont from the pampean formation of Azul, which is regarded as representing a new genus and species, under the name of *Carolibergia azulensis*.

WE have received from the director, Captain S. S. Flower, a copy of a handy little guide (with plan) to the Zoological Gardens at Giza, near Cairo. The general introduction is written in English, French and German, and the names of the animals are given in several languages. The issue of this guide may be taken as an indication that the institution under Captain Flower's charge is in a satisfactory and progressive condition.

THE latest issue, vol. lxxiii. part i., of the *Zeitschrift für wissenschaftliche Zoologie* contains three papers, all of a highly technical nature. In the first, Herr Max Abel treats of regeneration among the oligochætous worms; in the second, Herr J. Müller discusses our knowledge of the land planarians of the family Bipaliidæ; while in the third, Herr K. Hann describes the development of the common hydromedusan *Clava squamata*.

IN the December number of the *Zoologist*, Mr. F. Coburn describes and figures a specimen of the British wild goose named *Anser paludosus* by Strickland in 1858. The type of that form has been generally regarded as an old male of the bean-goose (*A. segetum*); but a specimen obtained in 1896 by him at St. Abb's Head, Scotland, leads Mr. Coburn to conclude that it is a perfectly valid species, characterised by its large size, long neck and large feet, as well as by its aquatic habits. Apparently the bird was well known to the Yorkshire "carr-men" and "marsh-men" half a century ago, but no examples are known to science save the type and the one procured by Mr. Coburn. Where can be the habitat of this apparently distinct species is now the question.

THE first three parts of the second volume of the *Records* of the Botanical Survey of India have been issued. Mr. J. J. Wood has compiled a list of plants mainly from the province of Chutiá Nagpur. This part includes a map of the district and two sectional diagrams. Mr. Gammie has recorded the results of his investigations into plants used during periods of drought. For the purpose of making bread, seeds of species of Indigofera,

Cyanotis and Panicum are used. Other sources of nourishment are the leaves of Amarantus, Rivea and Leptadenia. A systematic enumeration of the species of Calamus and Dæmonorops, by Mr. O. Beccari, is based mostly on plants growing in the Malayan Peninsula and the adjacent islands, and only a few species belong to India or Ceylon.

An addition to our knowledge of semiparasitic plants is made by Mr. S. Kusano, who contributes the result of his studies on *Buckleya quadriala*, a genus of the Santalaceæ, to the *Journal* of the College of Science, Tokio. The plant was found growing naturally on several hosts, some Dicotyledons and some Gymnosperms, but a decided preference and better development was displayed on the roots of Abies and Cryptomeria. The haustoria arise laterally in the young stage, but eventually appear to originate from the apex, or in reality in close proximity to the apex. A feature which has only been suggested for allied genera, *e.g.* secondary growth due to cambium, is in Buckleya so marked that the contour of the vascular strand is entirely changed and definite medullary layers become differentiated. Since the cambiums are adjacent and develop tissue to the same degree, the sucker keeps pace with the growth of the host root.

A brief critical review of the theories relating to plant evolution, more particularly the origin of new forms, is offered by Prof. Schwendener in a recent number of the *Naturwissenschaftliche Wochenschrift*. The article touches upon the origin of species by natural selection, the variations developed as special adaptations due to environment, the mutation theory and incidentally the production of hybrids. The arduous experimental work of De Vries and the possibilities of mutation or heterogenesis are acknowledged and accepted, but the opinion is expressed that new forms have not all originated after the same manner and that the direct action of external conditions has undoubtedly played an important part in the production of new and the modification of acquired characters. Prof. Schwendener is in accord with Darwin's theory of selection so far as it is limited to the origin of cultivated races of plants and to the breeding of domesticated animals, but does not believe in its application under natural conditions. This view, which coincides with the expressions of other eminent German botanists, naturally tends to diminish the importance previously attached to the theory of natural selection, but the writer pays just tribute to the value of Darwin's work, "whose service it was," he says, "to set on a new foundation the doctrine of descent, and after a struggle which was victoriously pursued to establish the idea permanently in biological science."

Prof. F. Frech contributes to the *Zeitschrift der Gesellschaft für Erdkunde* (Nos. 7 and 8) a series of studies of the climates of past geological times. He accepts the views of Arrhenius with regard to the effect of variations in the amount of carbonic acid gas in the atmosphere, and considers the changes in the distribution of land and sea as the factor of next importance. The review of the geological evidence is interesting and important, but the author hardly gives sufficient prominence to physical aspects of the question, especially the effect of changes of temperature distribution on the atmospheric circulation and the influence of oceanic currents upon climate. The maps of continents and seas at the end of the Carboniferous period and of Europe during the Glacial period are valuable.

Two more volumes of the excellent *Scientia* series of scientific monographs published in Paris by M. C. Naud have reached us, viz., "Le leucocyte et ses granulations," by Dr. C. Levaditi, and "Les phénomènes des métamorphoses internes," by Dr. J. Anglas. The volumes fully maintain the high character of preceding books in this series.

The Orient Steam Navigation Company announce the commencement of their 1903 season of pleasure cruises. No. 1 cruise, starting February 26, is to the Riviera and on to Palestine, calling *en route* at Tangier, Palma, Sicily, Crete and Cyprus, returning home by way of Alexandria, Naples, Algiers and Gibraltar. The second cruise, leaving London March 14, is to Tangier, Malaga, Nice, Palermo, Crete, Smyrna and Constantinople, visiting on the return voyage the Piræus (for Athens), Nauplia, Katakolo (for Olympia), Naples, Algiers and Gibraltar.

The reversible transformation of ammonium thiocyanate into thiourea has recently been investigated on a large scale by Reynolds and Werner, who give an account of their experiments in the *Journal* of the Chemical Society. At temperatures from 170°–180° C., the fused product obtained by heating either ammonium thiocyanate or thiourea for a sufficient time consists of 75 per cent. of the former and 25 per cent. of the latter. It is believed by the authors that the reversible change is partly conditioned by the greater stability at this temperature of a complex compound consisting of three molecules of thiocyanate and one molecule of thiourea.

The first number of vol. i. of the *Biochemisches Centralblatt* has just been published. In twenty-eight pages it gives abstracts of some sixty papers dealing with subjects which belong essentially to the borderland of chemistry and medicine. It is pleasing to note that a considerable number of these are auto-abstracts, for this method of summarising is the only one which ensures that the really essential points in the various investigations are brought forward. The issue also contains a short summary by N. Zuntz of the recent work which has been carried out in America on such an elaborate scale by Atwater and his co-workers on the metabolism of the animal body. To physiological chemists, the *Centralblatt* will no doubt prove of considerable value, serving, as it is intended to do, for the collection of reports on all published medico-chemical investigations.

The much-discussed question of the relationship between the red and yellow oxides of mercury may now be regarded as definitely decided. The experiments which lead to this conclusion form the subject of a paper by K. Schick, published in the last number of the *Zeitschrift für physikalische Chemie*. The results indicate that Ostwald's view that the difference between the two oxides is merely due to a difference in the size of the particles is the correct one, and that the older hypothesis, according to which the oxides are isomeric, is no longer tenable. Determinations of the solubility of the pure oxides in pure water at 25° C. show that they have practically the same solubility. Of the yellow oxide, one part dissolves in 19,300 parts of water, and one part of the red oxide in 19,500 parts. Such a small difference is due, in all probability, to the difference in the size of the grains.

The current number of the *Zeitschrift für physikalische Chemie* contains an interesting paper by Dr. M. Wildermann on chemical dynamics and statics under the influence of light. The author's object has been to ascertain, if possible, the law which regulate the velocity of chemical change and the condition of chemical equilibrium, when such change is conditioned by the introduction of light energy into the system. In other words, it was proposed to investigate whether the velocity is proportional to the amount of light absorbed in unit time independent of the concentrations of the reacting bodies. The special chemical change which has been studied is the union of carbon monoxide and chlorine, a reaction which takes place only under the influence of light. A theoretical discussion of the experimental results leads the author to conclude that the velocity of a chemical reaction which is brought about (or influenced) by

the introduction of light energy follows the same law in the light as in the dark. In the latter circumstances, the only active forces are those of chemical affinity. The influence of the light energy is therefore quite different in its effect upon the reacting substances from that of electrical energy, the effect of the latter being regulated, of course, by Faraday's law.

THE additions to the Zoological Society's Gardens during the past week include a Bennett's Wallaby (*Macropus bennetti*) from Tasmania, presented by Lady Boord; a Spotted Salamander (*Salamandra maculosa*) from Italy, presented by Mr. G. Bottini; two Bennett's Wallabys (*Macropus bennetti*) from Tasmania, a White-fronted Amazon (*Chrysotis albifrons*) from Cuba, three Ring-necked Parrakeets (*Palaeornis torquatus*, var.), a Gangetic Trionyx (*Trionyx gangeticus*) from India, a Ruff (*Machetes pugnax*), a Skylark (*Alauda arvensis albino*) British, a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, deposited.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE STAR 21, 1902, SAGITTÆ.—From photographs taken by M. S. Blakjo at Moscow, Madame Ceraski has found that the star having the position

$$1855\ \alpha = 20\text{h. }13\text{m. }47\text{s.},\ \delta = +20^\circ\ 39'\cdot0,$$
$$1900\ \alpha = 20\text{h. }15\text{m. }46\text{s.},\ \delta = +20^\circ\ 47'\cdot3,$$

is a variable.

The magnitude varies from 9·5 to 11·5 or a little more, and M. Blakjo believes the period to be a long one, perhaps several weeks or months. In September, the actual visual magnitude was 11·5 (*Astronomische Nachrichten*, No. 3836.)

"THE HEAVENS AT A GLANCE," 1903.—The seventh yearly publication of this handy card is full of useful astronomical information for amateur observers. In addition to the usual monthly "Celestial Diary," tables of "Sidereal Objects" and "Descriptive Notes," it contains two small star charts which will be found very useful. The card may be obtained from its compiler, Mr. Arthur Mee, Llanishen, Cardiff, price sevenpence, post free.

OBSERVATIONS OF LONG-PERIOD VARIABLE STARS.—In Nos. 3835-6 of the *Astronomische Nachrichten*, Father Esch, S.J., of Valkenberg, gives the detailed results of his observations of seventy-eight long period variables. The objects are denoted by their names and numbers in Hagen's "Atlas Stellarum Variabilium," and the dates of their maxima, with the amount of variation from the elements given in the Atlas, are given, together with their range of variability and remarks by the observer.

OBSERVATIONS OF OCCULTATIONS.—Mr. G. W. Hough, director of the Dearborn Observatory, gives the details of his observations of ninety-one occultations of stars by the moon, during the years 1900 and 1901, in No. 528 of the *Astronomical Journal*.

He divides the phenomena into four classes, and in the fourth class he places those in which the star appears to be projected on the earth-like disc of the moon for some seconds before the final disappearance; he explains this phenomenon by suggesting that, as the edge of the moon is not a smooth outline, the star may pass behind the moon at a point where there is a depression in the limb and so appear to be projected beyond the geometrical outline of that limb.

In the case of the occultation of the star D.M. + 20° 807 on February 25, 1901, the star apparently disappeared and the time was recorded, but it was seen again and a second record made 3·8 seconds after the first. This phenomenon was undoubtedly due to the reduction in light of a close double when the one component had passed behind the limb, for the object was afterwards identified as Ho 332, $p = 125^\circ\cdot9$, $s = 1''\cdot03$, 9m.–9m.

The phenomenon observed on the occultation of the star S D.M. – 20° 4810, on October 17, 1901 ($p = 106^\circ$), belonged to the fourth class mentioned above, for the star appeared to be projected on the limb of the moon two or three seconds before its disappearance.

THE VACCINATION ACTS.

THE present position of the law relating to vaccination in England is indefensible. There is probably no great question in the domain of medicine on which the medical profession are nearer to absolute unanimity than that of the value and necessity of vaccination as a protection against small-pox. Independently of professional authority, perhaps no medical doctrine has for its basis so great an amount of statistical evidence gathered over so wide an area for so long a time. This unanimity of belief and this statistical evidence are equally strong and of equal value as regards the primary vaccination of infants and the revaccination of adolescents.

It is not the purpose of this paper to cite any of the evidence in question. What the writer desires to point out here is that the existence in this country of Acts of Parliament making vaccination of children obligatory, or even providing expensive administrative machinery for the vaccination of persons voluntarily asking for it, must be taken as proof that Parliament accepts the conclusion that vaccination prevents small-pox. But the legislature is in the strange position of insisting on infantile primary vaccination and of making no requirement whatever regarding revaccination. At one time, and indeed up to a comparatively recent date, this attitude was defensible, for the great mistake of Jenner's life was that he believed a single vaccination to be sufficient for permanent protection, and the veneration naturally entertained for his name and work probably delayed general recognition of the need for repetition of the operation. That need, however, has now long been recognised, and the experience of Germany shows that vaccination in infancy and a single revaccination at a proper interval afterwards are sufficient to confer national protection against small-pox, though no doubt in any such protected nation or empire there will be individuals who owe their freedom from small-pox more to their being surrounded by a vaccinated and revaccinated population not liable to epidemics than to the permanence of their own personal immunity. No argument can be used in favour of a law of primary vaccination which is not also valid for a law of revaccination. If there is any reason for having no Revaccination Act, the same reason exists for having no Vaccination Act at all. Both should stand or fall together.

The importance of a Revaccination Act for England was prominently but unsuccessfully brought before Parliament when the law was being altered in 1898 by the passing of the temporary Act which came into force at the end of that year. The main features of that measure were the provision of domiciliary vaccination and the much-debated Conscience Clause. The Act was passed experimentally only for a period of five years, and comes to an end on December 31, 1903. Next session is practically certain to see one of two alternatives adopted by Government. Either new legislation will be introduced or the Act of 1898 will find a place in the Expiring Laws Continuance Bill. This latter course would shelve several questions which cry out for solution and ought not to be shelved. To prevent its adoption and to help Government to frame any new measure on the best lines are among the principal reasons for the formation of the Imperial Vaccination League, the first meeting of which was held in London lately under the chairmanship of the Duke of Northumberland. The League has other important objects before it. It desires to educate and interest the public generally in the subject of vaccination and revaccination. As concerns legislation, it has under consideration by separate subcommittees the questions of a Revaccination Bill, the supply of lymph prepared by Government or under Government supervision for the needs of the whole country, and the question of the proper local authority for the administration of the Vaccination Acts. The last of these, though an important administrative subject, is after all of much less public moment than the two others—the protection of the lymph supply and obligatory revaccination.

The risks attached to arm-to-arm vaccination in this country were greatly overstated by anti-vaccinationists. In no class of the population was arm-to-arm vaccination more uniformly resorted to than in the families of medical men, and the Royal Commission, which sat for the long period of seven years, concluded, after elaborate inquiry, that the risks were insignificant and were diminishing. Nevertheless, they recognised that the fear of injury from vaccination and especially the fear of syphilitic inoculation was a potent factor in hindering people from securing the protection of their children against small-pox.

Quite independently of such fears—and this also, of course, the Commission pointed out—it is the obvious duty of the State to take every practicable precaution to prevent harm to the individual through the operation of any Act of Parliament. This applies alike to vaccination and to hospital isolation. If, for the public good, a child is removed from the parental roof to a public hospital, the authority so removing it, and coming temporarily *in loco parentis*, is bound to exercise the utmost care in the protection of the child. Though vaccination differs from hospital isolation in respect that it is done directly for the benefit of the child and only indirectly for the good of the public, yet the obligation remains. Every risk, no matter how slight, should be minimised by every practicable and reasonably available means before the State compels the parent to procure the vaccination of his child. The demand, therefore, that Government shall itself supply for every required vaccination calf lymph treated according to the best known methods—methods which have been much improved since the Commission issued its Report—or shall efficiently supervise the manufacture of lymph by private makers, is a most reasonable one, and has the support alike of lay and medical opinion.

It is necessary to consider how this can be done. Here, as in every other mundane affair, questions of finance and economy arise. Before the Act of 1898 came into force, public vaccinators appointed by boards of guardians performed about half of the primary vaccinations done in London and about two-thirds of those done in the provinces. How the figures now stand I do not know, but at present all that Government undertakes with regard to lymph supply is to meet the requirements of public vaccinators. Private practitioners must find their own lymph. This, at first sight, seems a harsh and arbitrary rule, but it may be assumed that the Local Government Board has some ground for its attitude. The facts of the case furnish the explanation. For due removal of extraneous organisms, calf lymph has to be stored for one month in the glycerine with which it is mixed. If lymph be used too soon, insufficient removal of such organisms may result occasionally in an unnecessary degree of inflammation accompanying the formation of the vaccine vesicles. If stored too long, on the other hand, the lymph may become inert for purposes of vaccination. At present there is great irregularity of demand for vaccine lymph in England, depending on the absence of systematic revaccination and the occurrence of epidemics of small pox. If under present conditions the Local Government Board must always be ready to provide sufficient lymph to every medical man who asks for it for vaccination and revaccination during small-pox epidemics, a great establishment will have to be set up, producing month by month such amounts of lymph as may not be wanted at any time for ten or twenty years on end, and month by month this huge excess of valuable material will have to be thrown away. Merely to set forth such a scheme is to condemn it. How, then, is the object to be accomplished? The answer is, only in one way, and that way a Revaccination Act. Under such an Act, revaccination would be obligatory at about the age of twelve years. The information necessary for working the Act would be most readily obtained from the registers of the elementary schools. The vaccination officials would be furnished at frequent intervals, say every three months, with lists of children about to attain the specified age. Primary vaccination would, of course, remain obligatory as at present. Both revaccination and primary vaccination, it may be assumed, would be subject to a Conscience Clause, though the present Clause is open to considerable amendment. The work of vaccination would go steadily on. The Government laboratories would be on a scale suited to meet the requirements of the nation, and the public funds would not be squandered in maintaining an institution the full work of which would be utilised only at rare intervals. Outbreaks of small-pox would be few and local and limited in degree, and the laboratories would easily meet demands for lymph for revaccination of "contacts" and others on such occasions.

Another great advantage from systematic revaccination would be an enormous saving in the provision and maintenance of small-pox hospitals. At present, local authorities are, with regard to this matter, in a most exasperating position, and that through no fault of their own. The Local Government Board insists that, owing to an evil which has often resulted from such hospitals—the spreading of small-pox throughout the surrounding community—these institutions for the isolation of patients shall themselves be isolated. Small-pox is a disease for which hospitals are almost entirely unnecessary in a duly vaccinated and revaccinated community, yet local authorities have no power to enforce such protection of their community, and when they set about trying to provide hospitals, they experience the utmost difficulty in obtaining safe sites. Other economies would result from the scheme here briefly sketched, but the above are the main reasons for asking Government to introduce a Revaccination Bill, and are also among the main reasons for the formation of the Imperial Vaccination League. Already the Jenner Society has done most admirable work in the same field, and both are well worthy of public support, especially at so critical a time in the history of legislation for the prevention of small-pox.

In criticism of the plea for a Revaccination Act as here put forward, it may perhaps be urged that the acceptance without demur of a Conscience Clause with regard even to primary vaccination is hardly consistent with a demand for a law of revaccination. What would be the sense, it may be asked, of establishing all the additional machinery which a Revaccination Act would involve for the protection of the public against small-pox and at the same time telling the public that if they please they can evade both primary vaccination and revaccination by satisfying a bench of magistrates that they have a "conscientious" objection on the subject? The force of such a contention is not to be denied. Admittedly, the Conscience Clause is a concession to expediency. For justification of such a concession, we must go to the facts of the position. In the first place, it is important to note that the Royal Commission on Vaccination suggested a Conscience Clause with the object, not of lessening the practice of vaccination, but of increasing it. In the second place, even before the Conscience Clause was passed, vaccination was not in any real sense of the word compulsory. In order to evade the operation, it was only necessary to pay a fine, either once or repeatedly, according to the activity or otherwise of the local guardians. The law never allowed a local authority to take a child by force out of a parent's arms and vaccinate it. Exemption, therefore, though not by way of certificate, was always possible. Laws must be framed and administered with due regard to the spirit of legislation which prevails in the country. If it so pleases, Parliament has a right to adopt the attitude that, bad as are small-pox epidemics, they are a lesser evil than would be the exercise of absolute force in such a matter as the insertion of vaccine lymph into the arm of a child notwithstanding the determined opposition of the father. The fining of persistent and active anti-vaccinationists, the public sale of their goods in default of payment of such fines, or the imprisonment of objectors where payment of fines could not in this way be obtained, have been in the past measures most favourable to agitation against vaccination. The purpose of the Conscience Clause in the Act of 1898 was to sift the genuine and confirmed opponent of vaccination from the merely careless and indifferent parent who had no opinion on the subject, but would leave the matter alone so long as he himself were left alone, and would, on the other hand, have his child vaccinated if he found that that would cause him less trouble than to take the steps required to obtain exemption from the law. On the whole, the Conscience Clause of 1898 has probably promoted vaccination rather than hindered it. Yet in practice the clause has proved itself defective in two directions. Its administration has been left to benches of local magistrates, and their views vary much as to the proceedings which should be taken. In one place, an anti-vaccination bench may hold evening sederunts where long strings of alleged "conscientious objectors" pass rapidly in front of the bench and are detained only so long as is needed for adhibiting magisterial signatures to exemption certificates. At such gatherings, either fathers or mothers may attend. On the other hand, other benches of magistrates may refuse almost any evidence submitted to them on the ground that it does not "satisfy" them that conscientious objection exists, and in Parliament it has been stated, in answer to questions on the subject, that there is no power under the Clause to compel a magistrate to be "satisfied" with any amount of proof. A parent whose certificate is refused in such a court may afterwards be brought before it for having failed both to have his child vaccinated and to produce an exemption certificate. Obviously, the present Conscience Clause allows too much variety of practice and requires a substitute less open to these objections, a substitute which, if possible, should so detail the proceedings to be taken that, on the one hand, they would involve at least as much parental trouble as the procuring of vaccination would cause, and, on the other hand, would not

needlessly pester nor afford the notoriety of cheap martyrdom to any man sufficiently wrong-headed to be quite determined to resist the vaccinal protection of his child.

As regards the example of Germany, however, and the prospect of similar immunity, which I have ventured to hold forth as an inducement for the passing of a Revaccination Act in this country, it may well be asked, May not the operation of a Conscience Clause result in a condition of national protection far short of that of Germany? It is unsafe to prophesy here, but personally I am not very much afraid of that contingency. With such a well-organised system of vaccination and revaccination as could be easily and, I believe, very economically established, there would, I think, be comparatively little default throughout the country as a whole. The latest returns show that in London conscientious objection is registered with regard to about 1 per cent. of the children, and in the rest of England about 5 per cent. These figures might in the future alter either upwards or downwards, but with a well-thought-out Conscience Clause the change might be downwards rather than upwards. In some special localities, however, the amount of default might, at least for a time, be very considerable, and such places would be a danger both to themselves and to their neighbours. In Germany, a large part of the trifling amount of small-pox that still remains occurs near the frontiers where there is opportunity for importation of the infection from other less protected countries. We, however, have a sea boundary and are less exposed to such risks, so that the existence in our midst of imperfectly protected places might not be more than equivalent to the risk which Germany runs from its imperfectly vaccinated neighbours. Such places in England would have the benefit of being surrounded by a vaccinated and revaccinated nation. Small-pox would not readily reach them, and when it did the surrounding communities would, through their systematic revaccination, be in a much better position than at present to resist the variolous invasion. Moreover, when once small-pox gets a good footing (though, unfortunately, not until it really has a good footing) in an imperfectly protected community, it has a wonderful effect in temporarily promoting vaccination. When Gloucester had attained a higher percentage neglect of vaccination than any large town in England, the result of a great small-pox epidemic was to leave it the best revaccinated town in the realm. In presence of an outbreak in future, it would not be in the least surprising to find the names of some children appearing on two lists in the course of the same year, first as subjects of conscientious objection and later as subjects of successful vaccination. Looking to all the facts of the case, I think this country may be able to afford a Conscience Clause, and it would certainly be infinitely better off under a Revaccination Act with a Conscience Clause than without any Revaccination Act at all.

As reference has repeatedly been made here to the example of Germany, it may be proper just to indicate, in a sentence or two, its position with regard to vaccination and small-pox. The facts are taken from a very useful tract published by the council of the British Medical Association.[1] In Germany, vaccination of children in the course of their second year is compulsory, and also revaccination of all school children in their twelfth year. That has been the law since 1874. In the nine years 1866–74, the small-pox deaths per million in Prussia were, respectively, 620, 432, 188, 194, 175, 2432, 2624, 357, 95. In the years 1875–1898, the corresponding figures have been 36, 31, 3, 7, 13, 26, 36, 36, 20, 14, 14, 5, 5, 3, 5, 1, 1, 3, 4, 3, 0·8, 0·2, 0·2, 0·4. In Austria, without compulsory vaccination, the annual rates 1887–1896 have been 440, 640, 520, 250, 290, 260, 250, 110, 47, 35. The figures for all Germany do not begin until 1886, and are as follows in the years 1886–99:—4, 3·5, 2·3, 4·1, 1·2, 1·0, 2·1, 3·1, 1·7, 0·5, 0·2, 0·1, 0·3, 0·5. In short, "small-pox epidemics are utterly abolished from Germany, and only a few scattered deaths occur each year, mostly on the frontiers (Russia and Austria)."

As illustrating what has been said already about the protection derived from living in a vaccinated and revaccinated community, I quote in conclusion the following passage regarding the Prussian army:—

"The law of 1874 made no difference in the vaccination of the Prussian army, which enjoyed good vaccination ever since 1834: every recruit being vaccinated on joining—twice if necessary. But the law of 1874, which only directly affected infants and school children, made a great and striking difference in the small-pox mortality of the *army*. Previously there were a few deaths, one or two, almost every year, but after 1874 there was not a single death for ten years, and only two deaths (1884 and 1898) in the whole period 1875–98. The first death is that of a reservist twice unsuccessfully vaccinated in the army. This shows that the protection which an individual acquires by vaccination is increased by his being surrounded by a well-vaccinated community."

JOHN C. M'VAIL.

[1] "Facts about Small-pox and Vaccination," &c. (British Medical Association, 429 Strand, W.C.) Price 1½*d*.

AN AMERICAN REPORT UPON THE WEST INDIAN ERUPTIONS.[1]

DR. E. O. HOVEY, associate curator of the geological department of the American Museum of Natural History, New York, was sent by that institution to Martinique and St. Vincent to study the phenomena accompanying the great eruptions of Mont Pelée and La Soufrière of last year, and the report referred to below deals almost entirely with his personal observations. The report first discusses the May eruptions of La Soufrière, the author being a member of the first party, on May 31, to ascend that mountain after the eruptions of May 7 and 18. The party found that the old crater lake for which the volcano had been famous had disappeared, but that there was a small lake of (apparently) boiling water in the bottom of a precipitous pit nearly a mile in diameter at the top. The author and Dr. T. A. Jaggar, jun., who also was in the party making the ascent, estimated that the bottom of the pit was about 1600 feet below the part of the rim on which they were standing, or about 2400 feet below the highest part of the rim. A strong column of steam was rising, occasionally including clouds of dust, from the south-east quarter of the lake.

The wall between the great crater and the "New" or 1812 crater seemed intact, and from its lower third there issued a strong stream of water, apparently from waters then collecting in the 1812 crater. The rim of the crater and the upper part of the cone was covered with a thick mantle of mud, which rendered it unwise to attempt to reach the windward side of the volcano along the rim. Ten days later the author, accompanied by Mr. George C. Curtis, of Boston, who was his companion on the first and second ascent and during most of his stay on the islands, made a third and successful ascent from the windward side of the island and stood upon the peak between the two craters. It seemed evident that the small (1812) crater had not taken part in the May eruption, though the summit of the mountain was covered with clouds at the time of the visit.

The explosions attending the May eruptions of La Soufrière expended their strength radially in all directions from the crater. The principal evidence of this is the trees, which lie prone in directions pointing away from the crater, except for modifications due to local circumstances of topography. The roots of the upturned trees showed the effects of the sandblast action of the volcanic tornado, being worn and charred upon the portions toward the crater and preserving the fresh, unburned bark upon the protected parts. The explanation for the explosions suggested is that unusually great masses of superheated steam arriving at the lip of the crater could not find room for expansion upwards on account of the cushion-effect of the column of steam and lapilli preceding them, and the lapilli falling therefrom, and that they expanded with violence horizontally and downward, following the configuration of the mountain. Extensive landslides occurred for two or three miles along the leeward coast.

The particular feature of the May eruptions of La Soufrière was the enormous amount of dust which was thrown high into the air and distributed over a vast, elliptical area, the extent of which cannot yet be calculated for lack of data. The dust appears to have been carried much farther to the east and south-east by the upper currents of air blowing counter to the trade winds, than to the west by the trades. Reports from Barbados and from ships encountering the dust at sea indicate transport by the upper air currents at a rate of about thirty-two knots contrary to the direction of the prevailing surface wind. The other ejecta of the eruptions were fine and coarse lapilli, blocks and bombs. No *stream* of melted lava accompanied either of the outbursts in May. The lapilli first thrown out

[1] Martinique and St. Vincent: a Preliminary Report upon the Eruptions of 1902, by Edmund Otis Hovey. *Bulletin* American Museum Natural History, vol. xvi. pp. 333–372, pl. xxxiii.–li. New York, October 11, 1902.

were fragments of the ancient lavas and tuff agglomerates in the throat of the volcano, those coming out afterwards were unoxidised and seemed to consist of new material, which had solidified, however, before reaching the atmosphere, though the larger lapilli in the September eruptions seemed to be bits of ancient lavas.

FIG. 1.—La Soufrière, St. Vincent, from Richmond estate Effects of landslides and encroachment of the sea are shown along the coast. Photo by Clare E. Taylor.

The ejected blocks were of andesitic lavas, for the most part at least, and showed that they had been subjected to a high temperature, but had not been melted. Some of such blocks found four miles from the crater on the windward side were thought to weigh fifty pounds. The bombs noticed were of the "bread-crust" variety, similar to, but not as perfect as, those observed on Mont Pelée or those described by Johnston-Lavis and others from the 1888 eruption of Vulcano. Some of the bombs were of somewhat pumiceous and others of dense lava and they showed by their surface that they had been in a molten or half-molten condition in the throat of the volcano.

The great accumulations of hot lapilli and dust formed in the radial valleys, notably those of the Rozeau, Trespe and Wallibou rivers on the west and of the Rabaka dry river on the east, retained their heat for a long time after the eruptions and gave rise to secondary, or superficial, eruption phenomena of striking character and considerable interest. The river water and the water from the tropical showers percolating through the beds came into contact with the still highly-heated interior, causing violent outbursts of dust-laden steam. One such outburst from the Wallibou Valley near the sea, in the afternoon of May 30 sent up a column of such vapour fully a mile in height with all the cauliflower-like convolutions and mushroom-shaped top which are characteristic of a crater eruption-cloud. The Wallibou was so overloaded with volcanic ash that it could flow only in pulsations, intervals of from fifteen to forty seconds being needed for the stream to gather strength to push its way along with its load. The freshly fallen dry dust presented a ridged surface like that of wind-drifted snow.

The area of devastation on St. Vincent is very large in proportion to the total area of the island. After plotting it out carefully on the British Admiralty chart and measuring the area with a planimeter, I find that due to the May eruptions to be forty-six square miles, practically one-third the entire area of the island. From much of this devastated area, however, the ashes are being washed off so rapidly by the rain that vegetation is already asserting itself, and within another year crops will be growing there again.[1]

[1] Newspaper reports and private advices from St. Vincent show that the area of devastation has been extended on the leeward side of the island by the tremendous eruption of September 3-4 about four miles south of the boundary indicated on the map herewith presented, while the whole western portion of the devastated area got a heavy additional coat of lapilli. The windward side did not suffer materially from this eruption, but the eruption of October 15-16 extended the area on the windward side.

The deaths on St. Vincent are assigned, principally, to the following causes:—(1) most important, asphyxiation by hot, dust-laden steam and air; then (2), burns due to hot stones, lapilli and dust; (3), blows by falling stones; (4), nervous shock; (5), burning by steam alone, and (6), probably, strokes of lightning. The deadly character of the dust-laden steam undoubtedly was enhanced by the presence of a considerable percentage of sulphur gases (SO_2 and H_2S). The action of steam would account for the burns received under the clothing where the clothing was not charred. No autopsies were made on the bodies of persons killed by either volcano, so far as the author is aware. The positions in which many of the bodies were found indicated death by asphyxiation.

Mont Pelée.

The area of devastation caused by the eruptions of Mont Pelée from May 5 to August 28 was less than that caused by the May eruptions of La Soufrière. The author, after plotting it upon the Admiralty chart and measuring it with a planimeter, estimates the area most seriously affected at thirty-two square miles, but observes that the eruptions since August 28 have greatly extended the area to the north, east and south-east, probably more than doubling the earlier devastation. The area of distribution of the ejecta cannot be estimated with any degree of accuracy for lack of data. There is no reason for supposing that it is much, if any, less than the area affected by La Soufrière. The shocks or detonations from some, if not all, of the great eruptions were felt in Antigua, St. Kitts, St. Vincent, Trinidad and other islands, though not in the intervening islands of St. Lucia and Dominica.

The material ejected by Mont Pelée during the series of eruptions consists of dust in vast quantities, fine and coarse lapilli, bread-crust bombs of all sizes from one inch in diameter upwards, and blocks of small and great size, the cracked

FIG. 2.—St. Pierre Valley of the Roxelane or Rivière des Blanchiseusses in the northern part of the city, as it appeared May 22, 1902. Photo by E. O. Hovey.

condition of which shows that they had been highly heated. The bread-crust bombs are more perfect in their development than are those of La Soufrière. The largest mass which seemed to be a bomb, was one fifteen feet long, lying on the south-east slope of Morne Lacroix at an elevation of 3950 feet above the sea. Several bombs between 2 and 3 feet in longest dimension

were observed, and two were brought back to New York, one of which is now on exhibition in the American Museum. The largest ejected block noted was one upon the surface of the mud-flow between the Blanche and Sèche rivers, less than 200 yards from the sea-coast and about three miles from the crater. Its dimensions are $30 \times 24 \times 22$ feet, and it is of the light grey ancient andesitic lava, to be found in all places near the summit of the mountain. Many other great boulders, some of which are of nearly half the dimensions of the one just described, lie near by.

Four ascents of Mont Pelée, in the course of which the crater rim was traversed from the great chasm on the south-west along the southern and eastern edge, about two-thirds of the way around the circle, and the remainder also of the rim was clearly seen, the author was enabled to form a reasonably definite idea of the centre of activity of the volcano and what was going on therein. The crater is somewhat oval in shape, with the longest axis stretching north-east and south-west, and the highest point of the rim is on the north-east, and is what is left of the peak which is known as Morne Lacroix. The average between the readings of two barometers (one being in the hands of Mr. George C. Curtis, the companion of the author) determined the altitude of this peak as 4200 feet above the sea, the original height given upon the chart being 4428. The lava bed, forming what may be considered the rim of the crater on the south-east side of the gash, is 3350 feet above tide, while the real bottom of the gorge where it issues from the crater is 500 or 600 feet less in altitude. From this lava bed the rim rises rapidly ($30°$ to $35°$) to about 3750 feet above tide and then more gradually along the southern edge, until 3950 feet is reached on the eastern rim. The north-west side of the south-western gash is formed by a pinnacle of ancient lava, which appears to be about 4000 feet above the sea. From this point the rim drops somewhat toward the north, but gradually rises again toward the east until Morne Lacroix is reached again. This crater is estimated to be about half a mile across. The breadth of the rim varies from a mere knife-edge on the south, west, north and north-east sides to a sloping plateau 50 to 100 yards wide, on the eastern side. This plateau is the site of the shallow body of water known as Lac des Palmistes.

This lake basin was empty when visited by Prof. Heilprin on June 1, but was filled with dust and ashes when the author and Mr. Curtis visited the spot on June 18, 20 and 26. The author considers that the body of water known as Étang Sec, and not the Lac des Palmistes, was the real crater lake of Mont Pelée. The eruptions of the year 1902 have been for the most part from a vent which opened within the large crater at the head of the great gorge in the side of the mountain and just west of Étang Sec. The activity has built up a cone the top of which at the time the author left the islands, July 6, was not less than 4000 feet above the sea, indicating a growth of 1600 to 1700 feet within the two months of volcanic action which had then taken place. There was a crater visible in the top of this inner cone the breadth of which can only be guessed at as being about 400 feet. Measurements of the angle of slope of the outer side of the cone determined it to be $38°$ to $40°$, but there are precipitous portions. The material which rolls and slides down the south-west side of this cone continues directly into the cañon of the Blanche river. The steep-sided valley formed by the inner cone and the inner slopes of the great crater is a continuation of the gorge of the Blanche and rises rapidly from the south-western gash to the base of the rocky precipice of Morne Lacroix, where it may be 800 feet in depth. The valley probably continues round the northern side of the inner cone, rising in a spiral, for it appears at an elevation of at least 3600 feet on its eastern side between the inner cone and the rim of the crater on the north-west side of the great gash. There seemed to be a second centre of eruption of considerably less activity within the crater near the base of Morne Lacroix.

The history of the present series of eruptions may be epitomised somewhat as follows: the gradually returning activity of the volcano began to make itself very manifest in the latter part of April, since visitors to the crater found warm water in the basin of the Étang Sec on the 25th of that month, and the lake was "deep." Columns of dust-laden steam rose from an opening within the old crater on the east side of the Étang Sec and from one on the west side of the same basin, and cones rose about these openings. Water in large quantity collected in the old lake basin, assisted, perhaps, by a dam formed across the gorge by the ejecta from the western crater. The water was heated by the action of volcanic forces. On May 5 the heated waters of the crater broke through this dam and rushed, as a deluge of mud and boulders of all sizes, down the gorge of the Blanche river, and overwhelmed the Guérin sugar factory, which was situated at the mouth of the stream. On May 8 began the series of great explosions which have sent steam, laden with sulphurous gases, dust, ashes and stones, again and again over the south-west slope of the mountain with the violence of a tornado, several times reaching to St. Pierre and beyond. The author would explain the blasts in the same way as in the case of St. Vincent, but the great gash in the side of the crater of Pelée and the position of the neighbouring ridges concentrated the force of the explosions in a certain direction and along a comparatively narrow zone—and the city of St. Pierre with its 26,000 inhabitants and thousands of refugees lay in an amphitheatre, a regular *cul-de-sac*, directly in the path of the blasts.

The ruins of the buildings in St. Pierre, the prone trees of the city, the dismounted guns in the batteries of Morne d'Orange and Pointe Ste. Marthe, the position of the iron statue of Notre Dame de la Garde upon the edge of the bluff below and fifty feet from its pedestal and many other circumstances, are the evidences that a blast of tornadic violence swept over the city of St. Pierre from the direction of the crater of Mont Pelée. The degree of destruction diminishes from north to south, and the amount of volcanic ash and stones deposited upon the city becomes less and less in the same direction.

The causes of death on Martinique were the same as on St. Vincent, with the addition of crushing beneath falling walls and other objects and cremation in burning buildings. In connection with the eruptions of both volcanoes, the lack of respirable air probably caused many deaths.

FIG. 3.—Quarter-inch boiler-iron tanks in a distillery in the Fort Quartier of St. Pierre, showing holes made by bombardment of stones from Mont Pelée eruption. Photo by E. O. Hovey.

The author came to the conclusion that there were no real craters or centres of primary eruption anywhere on Mont Pelée, outside of the great crater, though there has been much secondary action along the lower portion of the Blanche, Sèche, Falaise, Grande and Prêcheur rivers and other of the streams the sources of which are high up upon the slopes of the mountain. The secondary action was due, as in the Wallibou Valley and elsewhere on St. Vincent, to the admission of water to the heated interior of great accumulations of volcanic ash. Mud-flows and mud-torrents have been very numerous down the gorges of these streams and on the intervening plateaus. Some of these flows have been due to the breaking of the temporary dams caused by the quantities of loose ash thrown across the stream during the secondary outbursts, but the most destructive, with the exception of the one overwhelming the Guérin factory, have been due to the saturation by rain of the accumulations of dust on the inner and outer slopes of the crater rim, producing fluid masses which have run down the slopes of the mountain and the radial gorges with the destructiveness of avalanches.

The electrical displays in connection with each of the great outbursts were on the grandest possible scale. Such displays characterised the eruption of La Soufrière in 1812 according to contemporary reports.

The author and Mr. Curtis spent four nights (June 17–21) at Morne Rouge, and visited the crater on June 18 and 20. They felt then and told the people that there was great danger to the town in case of succeeding great eruptions, and they saw no reason to suppose that the activity of the volcano was lessening. It was evident that, if the inner cone kept on increasing in height until it considerably overtopped the eastern rim, or, if the greater activity shifted to the eastern vent within the crater and behind the wall formed by the inner cone, the great south-western gash and its cliffs on the north would lose their directive influence, and the force of the explosions would be expended radially in all directions. The early telegraphic reports of the eruption of August 30 stated that the remains of Morne Lacroix had been blown away, which indicated that the violent activity had shifted to the east. Later and authentic reports by Prof. Heilprin made it clear that Morne Lacroix had not suffered much additional damage, and his photographs taken after that eruption show the top of the inner cone well above the crater rim. Hence the former supposition cited above proved to be correct.

PRIZES PROPOSED BY THE ACADEMY OF SCIENCES FOR THE YEAR 1903.

IN geometry, the Francœur Prize (1000 fr.) is offered for discoveries or works useful to the progress of pure or applied mathematics; the Poncelet Prize (2000 fr.) for similar work done during the ten years preceding the award; and the Grand Prize of the Mathematical Sciences (3000 fr.).

In mechanics, the extraordinary Prize of 6000 francs for work tending to increase the efficiency of the French naval forces; the Montyon Prize (700 fr.) for inventing or perfecting instruments valuable in the mechanical arts; the Plumey Prize (2500 fr.) for improvements in connection with steam engines; and the Fourneyron Prize (1000 fr.) for a theoretical or experimental study of steam turbines.

In astronomy, the Pierre Guzman Prize (100,000 fr.) for finding a means of communicating with any planet other than Mars; the Lalande Prize (540 fr.) for the most interesting memoir or observation valuable to the progress of astronomy; the Valz Prize (460 fr.) and the G. de Pontécoulant Prize (700 fr.) for similar work.

In physics, the Hébert Prize (1000 fr.) for the author of the best treatise or most useful discovery for the commercial or practical use of electricity; the Hughes Prize (2500 fr.) for the best discovery or work contributing to the progress of physics; the Gaston Planté Prize (3000 fr.) for an important discovery or invention in the field of electricity.

In statistics, a Montyon Prize (500 fr.) for a work on French statistics.

In chemistry, the Jecker Prize (10,000 fr.) for work in organic chemistry, and the La Caze Prize (10,000 fr.)

In mineralogy and geology, the Delesse Prize (1400 fr.) for a work bearing on geological or mineralogical science.

In physical geography, the Gay Prize (2500 fr.) for a work having for its end the determination, as precisely as possible, of a series of geographical positions in a French colony.

In botany, the Grand Prize of the Physical Sciences (3000 fr.) for a research on the various modes of formation and development of the egg in the Ascomycetes and the Basidiomycetes; the Bordin Prize (3000 fr.) to demonstrate, by a study of numerous and varied types, the generality of the phenomenon of double fertilisation, or digamy, in the Angiosperms; the Desmazières Prize (1600 fr.) for the best work published in the course of the preceding year on Cryptogams; the Montagne Prize (1500 fr.) for work on the anatomy, physiology, development or description of the lower Cryptogams; the Thore Prize (200 fr.) for a work on the cellular Cryptogams of Europe.

In rural economy, the Bigot de Morogues Prize (1700 fr.) for any work tending to forward the progress of French agriculture.

In anatomy and zoology, the Savigny Prize (1300 fr.) for the assistance of young travelling zoologists with especial reference to the study of the invertebrate animals of Egypt and Syria; the Da Gama Machado Prize (1200 fr.) for the best memoir on the coloured portions of the tegumentary system of animals.

In medicine and surgery, a Montyon Prize, three prizes of 2500 fr. and three mentions of 1500 fr. for discoveries or inventions relating to the improvement of medicine or surgery; the Barbier Prize (2000 fr.) for a discovery in medical, surgical or pharmaceutical science or in botany of curative value; the Bréant Prize (100,000 fr.) for the discovery of a radical cure for Asiatic cholera, or for pointing out the causes of the disease so that preventive measures leading to the eradication of the disease can be carried out; the Godard Prize (1000 fr.) for the best memoir on the anatomy, physiology and pathology of the genito-urinary organs; the Lallemand Prize (1800 fr.) for the encouragement of work on the nervous system; the Baron Larrey Prize (750 fr.) for a work treating of medicine, surgery or military hygiene; the Bellion Prize (1400 fr.); the Mège Prize (10,000 fr.); the Chaussier Prize (10,000 fr.) for the best book or memoir which has appeared during the last four years on legal or practical medicine.

In physiology, a Montyon Prize (750 fr.) for researches in experimental physiology; the Philipeaux Prize (900 fr.) for similar work; the Pourat Prize (1000 fr.) for a memoir on the action of high-frequency currents on the phenomena of life.

Other general prizes offered include the Binoux Prize (2000 fr.) for work on the history of science; Montyon Prizes (2500 fr. and 1500 fr.) for the discovery of any means rendering a dangerous trade less unhealthy; the Wilde Prize (4000 fr.) for a discovery or work on astronomy, physics, chemistry, mineralogy, geology or experimental mechanics; the Tchihatchef Prize (3000 fr.) for the encouragement of exploration in Asia by naturalists; the Cuvier Prize (1500 fr.); the Parkin Prize (3400 fr.); the Petit D'Ormoy Prize (two prizes of 10,000 fr.), one for pure or applied mathematics and the other for work in natural science: the Boileau Prize (1300 fr.) for researches in hydraulics; the Estrade-Delcros Prize (8000 fr.); the Cahours Prize (3000 fr.) for the encouragement of young promising chemists; the Saintour Prize (3000 fr.); the Tremont Prize (1100 fr.); and the Gegner Prize (3800 fr.).

Of these, the prizes bearing the names of Pierre Guzman, Lalande, La Caze, Delesse, Desmazières, Wilde and Parkin are expressly stated to be offered without distinction of nationality.

LONDON CONFERENCE OF SCIENCE TEACHERS.

THE fifth annual conference of science teachers arranged by Dr. Kimmins in connection with the Technical Education Board of the London County Council was held at the South-Western Polytechnic, Chelsea, on January 9 and 10. There was a larger attendance than in any previous year, between four and five hundred teachers and others accepting invitations to be present. Adopting the admirable practice of former meetings of selecting for consideration a subject which during the preceding year has been specially receiving attention in the educational world, arrangements were made to give the whole of the first two sessions to a discussion on the teaching of elementary mathematics, more especially the instruction in elementary geometry, and the interest manifested in the subject fully justified the choice. The third meeting was devoted to the teaching of botany in schools and colleges, and the last to methods of illustrating the instruction in chemistry by lecture experiments.

The customary invitation to teachers of science to send for exhibition during the conference home-made apparatus, designed by themselves to simplify their instruction, was not this year responded to with any heartiness. Leaving on one side the exhibits of the staff of the South-Western Polytechnic, the pieces of apparatus on view were few in number and in no way remarkable for the ingenuity displayed. At the same time, the experiments in plant physiology arranged by Mr. H. B. Lacey, of the Chelsea Polytechnic, to illustrate his paper at the third meeting, were well calculated to show teachers of botany how the odds and ends of everyday life can be utilised in the experimental illustration of science lessons.

The Teaching of Geometry.

The chairman of the Technical Education Board of the London County Council, Mr. H. Ward, presided at the opening meeting, and after emphasising the value of conferences to teachers, contrasted German and English systems of education; he based his hopes for the future of English education on a combination of the excellences of German methods with the elasticity and originality which characterise education in this country.

Sir William Anson, Parliamentary Secretary of the Board of Education, took the chair at the afternoon meeting of the first day. He confessed that, having been educated in the dark ages, when science and mathematics found but a small place—or perhaps he should more strictly say when mathematics had but a small place and science had no place at all—in the curriculum of the public schools, he came to listen with a perfectly unprejudiced mind to the discussion. After all, a comparison of various methods of teaching seemed to him to be for practical purposes as valuable as anything that could be done in the way of the training of the teacher. A grain of practice was worth a much larger proportion of theory, and it must be of great value to hear men who had been successfully engaged in teaching explain the difficulties of their subjects and the modes in which they brought their minds to bear upon the minds of those who had to be taught. The great secret of teaching was to bring their minds into immediate contact with the mind of the learner and to impart to him what they knew and the processes by which they learned it.

In the morning, papers were read by Mr. Usherwood, on the experimental method in geometry, and by Mr. Frank Castle, on the teaching of workshop mathematics. Mr. Usherwood related his experiences of teaching geometry to boys beginning the subject on a practical inductive plan, and advocated the use of paper-folding and similar expedients as means of encouraging the pupil's self-activity. Mr. Castle enumerated some of the shortcomings of the education given in the great public schools, and traced them to the rigid, iron-bound nature of the prevailing system. He referred to recent changes in the syllabuses of many public examinations as a hopeful sign that methods of mathematical instruction were becoming less academic and more suited to the practical needs of the present day. The subsequent discussion, in which the Rev. T. W. Sharpe, Dr. Hoffert, Mr. C. W. Bourne and others took part, showed that the work which has been accomplished by the committees of the British Association and of the Mathematical Association, in the direction of rationalising mathematical instruction, is, on the whole, meeting with the approval of practical teachers.

At the afternoon meeting, addresses on the teaching of geometry were delivered by Messrs. S. O. Andrews, W. D. Eggar and A. W. Siddons. Mr. Eggar said that the first object in the choice of exercises for a young boy beginning the study of geometry was to instil notions of lines, points, angles, areas, volumes and similar subjects, and this was best accomplished by simple measurement. A discussion followed during which Mr. Gerrans, referring to the recent changes in the mathematical requirements for university examinations, said that the universities had in the past deferred such alterations because of their doubt as to whether the schools were ready for change.

Rational Instruction in Botany.

The third meeting, under the presidency of Prof. Farmer, F.R.S., was devoted to a consideration of the methods of botanical teaching. During the course of his remarks, Prof. Farmer said that, examination syllabuses notwithstanding, the best way was to study a small part of the subject thoroughly and in all their instruction to help their students to think. Too little attention, he thought, was given to the economic aspects of the subject. He advocated a careful examination of the reasons, for example, of the peculiar conditions of the distribution of vegetation under beech and pine trees, and pointed out that such problems would lead to the discovery of the effects exerted by light, soil and other influences on growth. The effect of grass in an apple orchard was also instanced, and the information which could be obtained from the study of this problem in leading to an appreciation of the interaction of the grass growth in the matter of drainage and the supply of oxygen was pointed out. Prof. Farmer gave an interesting example of what he called a "museum of mismanagement," in the case of a larch plantation which had been planted on a mountain-side, though it should have been well known that the larch is a deep-rooted plant.

Two papers were read, one by Miss Lilian Clarke, on the rational teaching of botany, and the other by Mr. Lacey, on experimental plant physiology. Miss Clarke, in a preeminently practical paper, described how, by experiments in the laboratory and school-garden at James Allen's school, Dulwich, she has succeeded in making botany an interesting and educational subject of study for girls. She explained that though in the past this work has been somewhat in abeyance in the winter, they hoped in the future to be able, owing to the provision by the London Technical Education Board of a botanical laboratory, to be able to pursue the work without a break throughout the year. Mr. Lacey concerned himself more with the work of advanced students. He described numerous experiments, illustrated by an excellent series of lantern slides, to show how lessons in botany may be made more valuable by the utilisation of the common objects of ordinary life in the experimental work. The slides of botanical objects under the microscope which he also showed were of particular value to teachers in demonstrating how easy it is to supply the student with graphic illustrations of the objects of his study. The informative nature of the papers led to questions from the audience rather than a discussion.

The Art of Illustrating Teaching.

The last meeting, at which Prof. Callendar, F.R.S., presided, was taken up with a consideration of the methods of illustrating lectures by experiments and lantern slides. In introducing the speakers, Prof. Callendar insisted on the importance of experimental work in the teaching of physics and chemistry, and referred to the difference between experiments suitable for performance by the student and those necessary to illustrate the lectures of the teachers. Two addresses were given, one by Mr. G. S. Newth, on experimental illustration in the teaching of chemistry, and the other by Mr. Harold Busbridge, on the making of lantern slides. Mr. Newth, before proceeding to perform certain typical experiments, criticised in some particulars what is commonly known as the heuristic method of teaching, and complained that in important respects it misled the pupil and gave him wrong ideas as to the nature of the great generalisations called chemical laws. In the selection of experiments, he said, the teacher should choose those only which are really illuminative and never introduce one merely because it is amusing. Mr. Newth also gave invaluable hints to teachers as to how to avoid failure in their experiments. The experiments performed were well chosen and invariably met with the success which Mr. Newth's well-known manipulative dexterity led the audience to expect.

Mr. Busbridge provided teachers with practical assistance in the art of making lantern slides at a small cost. He left on one side all photographic methods and confined his attention to the elucidation of simple expedients which could be utilised by a teacher with very little experience of laboratory methods. In a short discussion which followed, Dr. Hoffert referred to an important consideration if the experimental illustration of the ordinary teacher of science in schools is to be improved, that is, the diminution of his duties if time enough is to be provided for him to prepare good, suitable lecture experiments. As Dr. Hoffert said, it is unreasonable to expect the science master to add to his already arduous work by staying after school hours to prepare experiments. All science masters should be given time enough during the hours in which the school is open in which to prepare the experiments necessary for satisfactory lessons in science.

A. T. S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is reported that the Italian Minister of Public Instruction has authorised the establishment of a post-graduate school of hygiene and medical jurisprudence in connection with the University of Turin.

At University College, London, Mr. V. H. Blackman will give a course of about six demonstrative lectures on microscopical technique in botany on Mondays during the current term, commencing Monday, January 19, at 4 p.m.

The *Daily Mail* states that the late Mr. F. J. Quick, of Eltham, and Trinity Hall, Cambridge, left his residuary estate to the University of Cambridge in trust, to apply the income in promoting the study of vegetable and animal biology, for which purpose the university will probably eventually receive between 50,000*l.* and 60,000*l.*

At a meeting last week of the Liverpool School of Tropical Medicine, it was announced that since the previous meeting 10,000*l.* had been collected or promised towards founding a chair of tropical medicine in University College, Liverpool, which had been accepted by the college authorities. Major

Ross has been elected to the chair, and his title will be the Sir Alfred Jones professor of tropical medicine. Dr. J. W. W. Stephens has been elected to the Walter Myers lectureship in tropical medicine.

AT the last meeting of the Lancaster Town Council, we learn from the *Lancaster Observer*, a letter was read from Prof. Percy Frankland, F.R.S., addressed to the principal of the Storey Institute, in which he announces his intention of giving to the Institute a sum of one hundred pounds to be devoted to the purposes of a "Frankland Prize" for chemistry, whereby the memory of his late father, Sir Edward Frankland, may be perpetuated in Lancaster, in which town he received his education and spent the early years of his life.

A NEW Technical College, the building of which has been completed at a cost of about 50,000*l.*, was opened at Wigan on Monday. Mr. R. B. Haldane, K.C., M.P., delivered an address, in which he said they had, through the enterprise of a few public-spirited people, established an institution which would take its place in that great organic structure of the national education which was slowly being built up. Referring to the question whether charters should be given to establish teaching universities in Manchester and Liverpool, Mr. Haldane said he was quite sure that, if not in a few weeks, at least in a few years, they would see those great centres of academic learning in full force, with full distinction of university power and stature.

IN November last, Prof. Schmidt accompanied the German Emperor to England, and went to Oxford to investigate the details of the Rhodes scholarships. He has just reported the results of his conference with the Oxford authorities to the Kaiser. The Berlin correspondent of the *Daily Mail* reports that in an interview Prof. Schmidt remarked:—"The German Government unreservedly acknowledges the great value of the Rhodes scholarships, and will do its utmost to assist German students to avail themselves of them. You may state that the prospects of our accepting the scholarships are altogether favourable. There are no fundamental difficulties whatever in the way. Nothing but the difference between German and English university requirements suggests possible obstacles, the preparatory education of German students being so far in advance."

AT the annual dinner of the Bristol University College Colston Society on Tuesday, Sir J. Crichton Browne, who was the principal guest, alluded to the subject of local universities. He said objections to universities were futile in consideration of the educational needs of the hour. What was wanted was not a lot of provincial universities, but a group of national English universities, which should collectively meet the higher educational wants of the country as a whole. Each university should have instructive features of its own, each adapted to its environment, but all supplying the best instructions, the highest culture and the finest discipline of the day. If Liverpool obtained the charter it sought, they would inevitably have modern universities in Manchester, Leeds, Durham, and Cardiff; and Bristol should not be content to be left out in the cold. It seemed inevitable that there would be a great extension of the university system in England; and there was no need to be afraid of going too far for some time to come, especially when one in 520 went now to Scotch universities, whereas only one in 5000 went to universities in England.

THE development of higher education in the United States continues rapidly. The registrar of Columbia University, Mr. Rudolf Tombo, contributes to a recent number of *Science* certain interesting university registration statistics which reveal that the opening of each new academic year shows a marked advance over the last. The statistics are those of the beginning of November of last year, and deal with eighteen of the leading American universities. For the session preceding that with which the statistics deal, the relative rank of the seventeen leading universities on the basis of total enrolment was as follows:—Harvard, Columbia, Michigan, Chicago, California, Minnesota, Cornell, Wisconsin, Yale, Pennsylvania, Northwestern, Indiana, Nebraska, Missouri, Princeton, Leland Stanford and Johns Hopkins. If the students attending courses for teachers are counted, the total number for Harvard is 5468 and that for Columbia 5352. Chicago has had a considerable increase of students, and in Mr. Tombo's table ranks third, with 4296. Syracuse, which is included in the table for the first time, has a larger enrolment than Indiana. The teaching staff at Harvard numbers 533, at Columbia 504; and at the Johns Hopkins University, where the total number of students is only 669, there are 147 teachers of different grades. Indiana seems to have the smallest staff, viz. 65 teachers for 1648 students.

THE Senate of the University of London has adopted a scheme for the inspection of schools and for a school-leaving examination in connection with which school-leaving certificates will be awarded. The purpose of the scheme is to secure that the new certificate shall admit the holder as a matriculated student of the University without further examination at the age of sixteen years, and that schools shall have freedom in the selection of the subjects of study pursued by their pupils. For pupils only able to attain the necessary standard in some, but not all, of the subjects required for the school-leaving certificate, their attainments will be set out on a school record. Opportunity will be afforded to the more capable pupils of obtaining credit for advanced work. As the course of study pursued by a pupil at school, his age, the period during which he has attended school, the subjects in which he has reached the standard required by the University, and also any form of manual, artistic or technical skil will be set out on the record, it should become a valuable testimonial to the pupil on entering life. In order to maintain the same standard for the matriculation examination and the school-leaving examination, the University proposes to appoint a small board of inspectors, consisting of persons of distinction and large teaching experience, who will act as moderators for the matriculation examination and be responsible for maintaining the standard of the school-leaving certificate.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 20, 1902.—"On the Correlation of the Mental and Physical Characters in Man." Part ii. By Alice **Lee**, D.Sc., Marie A. **Lewenz**, B.A., and Karl **Pearson**, F.R.S.

In a second paper on this subject read before the Royal Society, the following conclusions were reached:—

In order to meet an objection raised at the discussion on the first paper, the correlations were found, for the Cambridge graduates, between

(1) Intelligence and the ratio $\dfrac{\text{length of head}}{\text{stature}}$,

(2) Intelligence and the ratio $\dfrac{\text{breadth of head}}{\text{stature}}$;

both of these results came out even smaller than the correlations of intelligence and absolute head measurements.

The correlation between auricular height and intelligence in school boys was found to be insensible. The statement made by MM. Vaschide and Pelletier in the *Comptes rendus* that there is a correlation in this case appears to be based on meagre material and defective method.

The correlations between intelligence and (1) strength of pull, (2) strength of squeeze, (3) long sight are all negative, that is, the honours men have less strength and shorter sight than the pass men, but here again all these values are less than the probable errors, and consequently no weight can really be attached to them individually.

The correlation between intelligence and weight is slightly larger than the probable error.

The correlations of intelligence with

(1) The ratio $\dfrac{\text{weight}}{\text{stature}}$,

(2) The ratio $\dfrac{\text{weight}}{(\text{stature})^2}$,

(3) The ratio $\dfrac{\text{weight}}{(\text{stature})^3}$

were found indirectly by formulæ, and (1) was also found directly; here again the results are of the same insignificant character as when absolute weights are taken.

Summing up the results of the calculations based on the Cambridge measurements, we come to the conclusion that the

honours men are slightly heavier, have slightly longer and broader heads, are not quite as tall or as strong as the poll men, and are slightly more short-sighted.

In no case, however, is the correlation sufficiently large to enable us to group the honours men as a differentiated physical class or to predict the intellectual capacity from the physical characters of the individual.

From the school measurements, the relation was investigated of athletics to health and to intelligence; there was found to be a sensible, but not marked, correlation between good health and intelligence; a marked correlation (0·4570) between good health and athletics, and a correlation of 0·2133 between intelligence and athletics.

Thus, while the intelligent are only slightly the more healthy, the athletic are notably the more healthy and are considerably more intelligent than the non-athletic.

It was found also that the athletic are the more popular and the more noisy, and tend to quick rather than to sullen temper. So far as the athletic character in the school-boy enables us to form a general estimate, the expressions "flannelled fool at the wicket" and "muddied oaf at the goal" seem hardly warranted.

Mathematical Society, January 8.—Dr. Hobson, vice-president, in the chair.—Dr. **Larmor** described the origin and progress of the movement for presenting to Mr. R. Tucker a permanent mark of appreciation of his services to the Society during his long tenure of the office of honorary secretary. The presentation was made by the chairman.—The following papers were communicated:—Prof. A. **Lodge**, Note on a method of representing imaginary points by real points in a plane. There is a (2, 2) correspondence of pairs of imaginary points, represented by conjugate imaginary coordinates, with pairs of real points. When the straight line joining the pair of imaginary points is real, the straight line joining the corresponding pair of real points cuts it at right angles. Examples of the application of the method to problems relating to conics were shown.—Dr. J. **Larmor**, On the mathematical expression of the principle of Huygens. The paper contains a direct intuitive proof of the integral formula put forward by Kirchhoff as the analytical expression of Huygens' principle. The proof is based on a method, analogous to that used by Green in the theory of potential, for determining, by means of its singularities, a function which satisfies the characteristic differential equation of wave propagation Extensions of the same method to the conduction of heat in crystals and to electric waves are given. The redundancy of the data in Kirchhoff's formula is noted, and a comparison is made of the merits of this formula and of a well-known integral formula given by Poisson, considered as possible foundations for the principle of Huygens.—Prof. A. E. H. **Love**, Wave motions with discontinuities at wave-fronts. It is shown that when the wave motion is represented by means of a function which is not itself discontinuous at the front or rear of an advancing wave, the validity of the integral formulæ given by Poisson and Kirchhoff for the representation of the function is not impaired by a discontinuity in the differential coefficients of the function at the front or rear of the wave. Certain classes of waves admit of being resolved into series of pulses, propagated independently of each other, the front and rear of a pulse being nodal wave-fronts presenting discontinuities of this type. This is the case for spherical sound waves and for electric waves of certain kinds. The paper contains a new explanation of the approximately rectilinear character of the propagation of light, according to which this character does not depend upon the periodicity of the waves, but upon the existence of a series of nodal wave-fronts.—Dr. H. F. **Baker**, Of functions of several variables. The paper is concerned with the problem of expressing a function of several variables, without essential singularities at points where the variables are finite, as a quotient of two integral functions. If p is the number of complex variables, the integral functions can be represented by integrals taken through $(2p-1)$-fold domains which are bounded by $(2p-2)$-fold loci. The domains of convergence of multiple power series are discussed, and the question of the existence of series of simpler functions capable of representing multi-periodic functions without finite essential singularities is considered.—Mr. W. H. **Young**, On non-uniform convergence and the term by term integration of series. The case of term by term integration considered in the paper is the most general possible. Incidentally, the most general distribution of the points of non-uniform convergence of a series of point-wise discontinuous functions the sum of which is at most point-wise discontinuous is found.—Prof. L. E. **Dickson**, Generational relations for the abstract group simply isomorphic with the linear fractional group in the Galois field $[2^n]$.—Rev. F. H. **Jackson**, Series connected with the enumeration of partitions (second paper).—Prof. W. S. **Burnside**, (1) On the Jacobian of two binary quantics considered geometrically, (2) On the resolution of some skew invariants of binary quantics into their factors in terms of their roots.—Mr. J. **Brill**, On the minors of a skew symmetrical determinant.

Geological Society, December 17, 1902.—Prof. C. Lapworth, F.R.S., president, in the chair.—Note on the magnetite-mines near Cogne (Graian Alps), by Prof. T. G. **Bonney**, F.R.S. These mines are situated in the Val de Cogne, one of the larger tributaries to the Val d'Aosta from the Graian Alps. At Filon Licone, the mass of magnetite is probably about 80 or 90 feet thick and some five times as long. At the Filon Larsine, the mass apparently is not nearly so thick. The ore is a pure magnetite, jointed like a serpentine, a thin steatitic film being often present on the faces. At both localities, the magnetite is found to pass rapidly into an ordinary serpentine, the transitional rock being a serpentinised variety of cumberlandite. The serpentine is intercalated between two masses of calc-mica-schists, with which green schists (actinolitic) are as usual associated, no doubt intrusively. The author discusses the relations of the magnetite and serpentine, which, in his opinion, indicate that a magnetitic must have been separated from a peridotic magma at some considerable depth below the surface, and the former, when nearly or quite solid, must have been brought up, fragment-like, by the latter; as in the case of metallic iron and basalt at Ovifak (Greenland).—The elk (*Alces machlis*, Gray) in the Thames Valley, by Mr. Edwin T. **Newton**, F.R.S. During the construction of the Staines reservoirs, some mammalian remains were obtained from the alluvium of the Wraysbury River, near the Thames at Youvenev, and the author has recognised among them the skull and antlers, with other parts of the skeleton, of a true elk (*Alces machlis*). These are described. It appears that *Alces machlis* has been frequently found in peaty deposits in many parts of Great Britain and on the continent of Europe, but never in Britain in association with the mammoth; and it seems probable that in Europe and North America it was a rare animal in Pleistocene times, if indeed it was present before the close of that period.—Observations on the Tiree marble, with notes on others from Iona, by Mr. Ananda K. **Coomáraswámy**. The gneiss near Balephetrish has a general south-westerly and north-easterly trend, and the limestone occurs in it as lenticles. Descriptions of the varieties of the limestone in this locality are given. The inclusions comprise those of gneiss containing quartz, felspars, hornblende, augite, scapolite and sphene as characteristic minerals, and mineral-aggregates consisting of sahlite, coccolite, scapolite, sphene, apatite, calcite and mica. The contact-phenomena are not specially well displayed. The dynamic phenomena include the rounding of the minerals and the formation of "augen." The carbonates are present as a fine-grained granular matrix. Although there are exceptions, gneiss-inclusions and mineral aggregates have usually been protected from the effects of extreme pressure. The description of minerals includes carbonates, pyroxene, amphibole, forsterite, scapolite, sphene, mica, apatite and spinel. Various marbles are described from Iona, where they are associated with actinolite-felspar schists and others; they are included in the gneiss.

MANCHESTER.

Literary and Philosophical Society, January 6.—Mr. Charles Bailey, president, in the chair.—Prof. F. E. **Weiss** gave an account of some of the botanical features of Western America. He began with a description of some of the work done at the experimental farms, and mentioned that Dr. Saunders, of the Experimental Station at Ottawa, had been able to obtain a hybrid between the Siberian crab-apple and a larger apple, which was able to grow and fruit freely in Manitoba. He then described the vegetation of the Rockies and the Selkirks, and pointed out the gradual change in vegetation in passing on to California.

DUBLIN.

Royal Dublin Society, December 16, 1902.—Prof. W. E. Thrift in the chair.—On the conservation of mass, by J. **Joly**, F.R.S.—An account of preliminary experiments made with a view to find if a mass change attended such physical transformations as formed the subject of Herr

Heydweiller's recent experiments. The reacting substances are suspended freely, but in separate vessels, at one extremity of a torsion balance the beam of which lies in the meridian, and at noon or midnight the reaction is started by contrivances described in the paper. A deflection of the beam is looked for, or a change in its angular velocity. A loss or gain of mass involves the energy associated with the inertia of matter moving with the earth's velocity, and on the assumption either that the momentum or kinetic energy is conserved, the possibility arises that a mechanical effect on the whole mass may become apparent. The results so far are negative, that is, no gross mechanical effect has been obtained. If such exists, it is not of a magnitude corresponding to the weight-change observed by Heydweiller. Several of Heydweiller's reactions were repeated. The method of observation is being improved.—Improved polarising vertical illuminator, by J. **Joly**, F.R.S. This is an improvement on a method previously described by the author of observing sections of transparent rock-forming minerals by light which has been twice transmitted through the section, the object being to increase the colour differences due to birefringence and so increase the discriminative value of the phenomena.—Prof. T. **Johnson** exhibited specimens of swede-rot, due to Phoma, received from County Down and not hitherto observed in Ireland. The fungus agrees in its characters with *Phoma Brassicae*, Thüm., causing a rot of fodder cabbages in France. It appears identical, including the pink colour associated with the conidia escaping from the pycnidia, with the Phoma described by Potteras causing a turnip-rot in the north of England.

Royal Irish Academy, January 12.—Prof. Atkinson, president, in the chair.—Prof. C. J. **Joly** read a paper on the quadratic screw system: a study of a family of quadratic complexes. He believes that the memoir contains a fairly full account of the arrangement of the screws in this important family. The method employed is that indicated in the author's note on systems of rays in the appendix to the new edition of Hamilton's "Elements of Quaternions."

EDINBURGH.

Royal Society, December 15, 1902.—Dr. Munro in the chair.—Prof. James **Walker** and Mr. A. J. **Robertson** communicated a paper on freezing-point depression in electrolytic solutions. The interest of the paper lay in the method adopted and in the great delicacy of manipulation required. In all experimental attempts to measure the freezing-point depression of solutions, the divergence of the actually observed temperature is known to depend upon the difference between the true freezing point and the "convergence temperature," and on the rate at which ice is formed or dissolved. The true freezing-point will be registered if either the convergence temperature and the true equilibrium temperature are identical, or the rate of formation or fusion of ice infinitely great. The experimental method adopted was that suggested by the latter condition. For a given quantity of solution, the more ice taken and the finer its division the more rapidly will the equilibrium temperature be restored after any disturbance, and the more closely will the apparent and true freezing points coincide. In the experiments described, the quantity of ice used was never less than 12 per cent. of the weight of the solution. The concentration of the solution was determined immediately after the determination of the freezing-point depression by filtering off a quantity of the liquid and analysing it. A complete experiment consisted in first determining these quantities for an approximately decinormal solution of acetic acid, and immediately thereafter the same magnitudes for a solution of a good electrolyte of approximately the same freezing point. The validity of the method was first tested by experiments with malonic acid which obeys Ostwald's dilution law; and then freezing-point experiments were made on certain strong electrolytes for which previous observers had obtained results which were not accordant with the ionisation values obtained from the conductivities. Taking into account all the difficulties and disturbing factors in experiments of this kind, the authors conclude that their results tend to increase confidence in the methods of exact cryoscopy.—Dr. G. A. **Gibson** gave a preliminary statement as regards the condition of the blood in cyanosis. He showed that the blood is always of high specific gravity, while the amount of hæmoglobin is increased. The number of the red blood corpuscles is almost invariably raised, sometimes to a very great degree, and the white blood corpuscles are usually increased to a considerable extent. The object of the communication was to show that, although in cyanosis the different elements of the blood are increased throughout the whole vascular system, yet the increase is not uniform, as it is greatest in the veins, less in the capillaries and least in the arteries. Some years ago, the author brought forward the hypothesis that this increase in the blood elements is compensatory and is produced by the lessened destruction of the blood in consequence of diminished oxygenation. This explanation appears to be borne out by the fact that there is an increase in arteries, capillaries and veins, but the results of the present investigation show that any method based upon the assumption of a uniform condition of the blood throughout the system is fallacious. The concluding part of the paper was devoted to the effect of oxygen in cases of cyanosis, and the result of its employment thus far is to show that its effect upon the blood in cyanosis is inappreciable.—Dr. **Gibson** also gave a lantern demonstration on cases of acromegaly and gigantism.

PARIS.

Academy of Sciences, January 5.—M. Albert Gaudry in the chair.—Remarks on the composition of the gases from the fumeroles of Mont Pelée, and on the origin of volcanic phenomena, by M. Armand **Gautier**.—The results of the analyses of the gases from the volcanic fumeroles of Mont Pelée recently made by M. Moissan are compared with the analyses by the author of gases extracted from igneous rocks by heating to a red heat in a vacuum. The gases are qualitatively the same and of similar composition quantitatively, and a theory of volcanic action is deduced from these considerations.—A new examination of the objections of M. Leduc relating to the proportion of free hydrogen in air, by M. Armand **Gautier**. It is held that M. Leduc has not succeeded in answering the objections raised by the author in his last note, and in particular it is pointed out that air which has passed over 10 centimetres of red-hot copper oxide cannot be assumed to have been freed from all traces of combustible gases, since a portion of the hydrogen and methane in the air escape combustion even after passing over three times this length of glowing copper oxide.—On the use of the stereoscope in topography and in astronomy, by M. le Colonel **Laussedat**.—On some facts of endomorphism observed in the ruins of St. Pierre. Martinique, by M. A **Lacroix**. A description of the phenomena which have taken place on the contact of iron materials with fused silicates, and showing the facility with which a volcanic rock, accidentally fused and kept in contact with divers materials, attacks them and transforms them both chemically and mineralogically.—On universal functions in space, by M. A. **Korn**.—On a new classification of the modes of nomographic representation of equations with any number of variables, by M. Maurice **d'Ocagne**.—A new method of testing rails, by M. Ch. **Frémont**. Three modes of testing rails are in actual use: by extension, flexure under a statical charge, and flexure by shock. In the testing by flexure under a sudden load, which is of the highest practical importance, it is assumed that the rails are homogeneous, a condition which is by no means fulfilled in practice, and it is this want of homogeneity which is frequently the cause of the discordance between the results of the trial and those of practice. A method of testing is described in which this defect is avoided.—On a plane representation of space and its application to graphical statics, by M. B. **Mayor**.—On the dielectric cohesion of gases, by M. E. **Bouty**. When the pressure of the gas is of the order of some centimetres of mercury, the critical field necessary to overcome the dielectric cohesion of the gas is a linear function of the pressure; at very low pressures, it is not the field, but the difference of total potential corresponding to the thickness of the gaseous column which remains constant.—On the statical work of muscle, by M. Charles **Henry**.—On the absolute value of the magnetic elements on January 1, 1903, by M. Th. **Moureaux**. A table is given showing the absolute values and secular variation of the magnetic elements at the Val-Joyeux Observatory.—On the activity of some salts of the rare earths as producing oxidation, by M. André **Job**. A solution of cerous acetate, although perfectly stable towards air, rapidly oxidises a solution of hydroquinone to quinhydrone. The acetate of lanthanum behaves similarly, from which the conclusion is drawn that a peroxide of lanthanum must be capable of existence.—On two new methods of synthesis of the oxyphosphinic

acids, by M. C. **Marie.**—On bromo-isopyromucic acid, by M. G. **Chavanne.** From the experiments described, it is probable that the constitution of isopyromucic acid remains still uncertain.—On a cellular structure in amorphous bodies, by M. G. **Cartaud.** The free surface of some suddenly cooled metals and some collodion films presents the appearance of a microscopic cellular tissue. In some cases, each cell contains a circular nucleus in relief.—The oxidation of ammonia and amines by catalytic action, by M. A. **Trillat.** The action of a red-hot platinum wire on a mixture of amines and air has been studied; in presence of water, ammonia is transformed into a mixture of nitrate and nitrite, amines of the fatty series are decomposed and give the separate oxidation products of the alcohol and ammonia, and in the case of the aromatic amines the oxidation chiefly takes place in the chains containing alkyl groups.—The diminution in the amount of lecithin in heated milks, by MM. **Bordas** and Sig. de **Raczkowski.** Milk which has been sterilised by boiling over the naked flame, or by heating at 110° in an autoclave, loses about one-third of its lecithin, and it is possible that some of the digestive troubles traced to the use of sterilised milk may be due to this cause.—On the presence of labial kidneys and a phagocytal organ in the Diplopoda, by M. L. **Bruntz.**—On a new ergometer, by MM. Th. **Simon** and J. Ch. **Roux.** A description of a simple form of ergometer capable of measuring the work done by a muscle in the index finger.—Contribution to the study of locomotor reflexes, by M. Maurice **Philippson.**—On the revivification of the heart. The production of beating of the human heart thirty hours after death, by M. A. **Kuliako.** The heart removed from the body of an infant, aged three months, thirty hours after death, was submitted to an artificial circulation by the method of Langendorff with warm Locke's solution, saturated with oxygen. The heart commenced to beat after twenty minutes and the entire heart gave regular pulsations for an hour.—Researches on the physiology of the skin, by MM. N. **Vaschide** and Cl. **Vurpas.**—An earthquake at Smyrna, by M. **Yung.**

DIARY OF SOCIETIES.

FRIDAY, JANUARY 16.

ROYAL INSTITUTION, at 9.—Low Temperature Investigations: Prof. Dewar, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Discussion on the Bearing of Outbreaks of Food-Poisoning upon the Etiology of Summer Diarrhœa. Opened by Dr. Newsholme.

TUESDAY, JANUARY 20.

ROYAL INSTITUTION, at 5.—Physiology of Digestion: Prof. A. Macfadyen.

ZOOLOGICAL SOCIETY, at 8.30.—Report on his Expedition to Uganda: J. S. BUDGETT.—On the Brain of *Nasalis* and some other Old-World Monkeys: F. E. Beddard, F.R.S.—On the Fishes collected by Mr. G. L. Bates in Southern Cameroon: G. A. Boulenger, F.R.S.—On the Anatomy of the Gephyrean *Phascolosoma teres*, n.sp.: W. K. Hutton.

SOCIETY OF ARTS, at 8.—The Principles which should guide all Applied Art: G. F. Bodley.

ROYAL STATISTICAL SOCIETY, at 5.—The Finances of Federal Government for the United Kingdom: Hon. T. A. Brassey.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion of paper on* Electric Automobiles: H. F. Joel.

WEDNESDAY, JANUARY 21.

CHEMICAL SOCIETY, at 5.30.—Researches on Silicon Compounds. Part VIII., Interactions of Silicophenylamide with Thiocarbamide: J. Emerson Reynolds.—Phenccycloheptene: F. S. Kipping and A. E. Hunter.—(1) On the Relation between the Absorption Spectra and the Chemical Structure of Corydaline, Berberine and other Alkaloids; (2) The Absorption Spectra of Laudanine and Laudanoxine in Relation to their Chemical Constitution: J. J. Dobbie and A. Lander.—The Influence of Molybdenum and Tungsten Trioxides on the Specific Rotations of 1-Lactic Acid and Potassium 1-Lactate: G. G. Henderson and J. Prentice.—Estimation of Ethyl Alcohol in Essences and Medicinal Preparations: T. E. Thorpe and J. Holmes.—Carbon Monoxide as a Product of Combustion of the Bunsen Burner: T. E. Thorpe.—Derivatives of β-Resorcylic Acid and of Protocatechuic Acid: W. H. Perkin, Jun., and E. Schiess.—Synthesis of Imino-ethers. N-Ethyl-, Methyl-, and Benzylbenzimino-Ethers: G. D. Lander.—(1) A Synthesis of 1.3.5. Triphenyl-2.4-Dimethylcyclopentane and of 1.3.5 Triphenyl-2-Methylcyclopentane; (2) The Condensation of Phenyl-Ethylketone (propiophenone) with Benzalaceto-Phenone, and of Acetophenone with Benzalpropiophenone: R. D. Abell.—Formation of Carbazoles by the Interaction of Phenols, in the Orthoketonic Form, with Arylhydrazines: F. R. Japp and W. Maitland.—(1) Dimorphism of α-Methylanhydracetonebenzil; (2) The Oxidation Products of the Methyl Homologues of Anhydracetonebenzil: F. R. Japp and A. C. Michie.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—The president (Mr. W. H. Dines) will deliver an Address on "The Method of Kite-Flying from a Steam Vessel and Meteorological Observations obtained thereby off the West Coast of Scotland."

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Annual Address.

SOCIETY OF ARTS, at 8.—The Metric System: A. Sonnenschein.

GEOLOGICAL SOCIETY, at 8.—The Figure of the Earth: Prof. W. J. Sollas, F.R.S.—The Sedimentary Deposits of Southern Rhodesia: A. J. C. Molyneux.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.—Address by the President.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable papers*:—Preliminary Note on the Relationships between Sun-spots and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—Characteristics of Electric Earth-Current Disturbances and their Origin: J. E. Taylor.—Solar Eclipse of 1900, May 28. General Discussion of Spectroscopic Results: J. Evershed.—On the Electrodynamic and Thermal Relations of Energy of Magnetisation: Dr. J. Larmor, Sec. R.S.

SOCIETY OF ARTS, at 4.30.—Indian Domestic Life: J. D. Rees.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on the Metric System. Opened by Mr. Alexander Siemens, in favour of the Metric System, and by Sir Frederick Bramwell, Bart., in favour of the British System.

FRIDAY, JANUARY 23.

ROYAL INSTITUTION, at 9.—Recent Volcanic Eruptions: Dr. Tempest Anderson.

SATURDAY, JANUARY 24.

MATHEMATICAL ASSOCIATION, at 2.—On some Class Diagrams for Intuitional Geometry: E. M. Langley.—On the Representation of Imaginary Points on a Plane by Real Points: Prof. A. Lodge.—Incommensurables by Means of Continuous Decimals: Edwin Budden.

CONTENTS.

THURSDAY, JANUARY 22, 1903.

RADIATION AND SPECTROSCOPY.

Handbuch der Spectroscopie. Vol. ii. Von H. Kayser. Pp. xi + 696. (Leipzig: Hirzel, 1902.) Price 2*l.* net.

THE second volume of this important work follows the first after a remarkably short interval of time. Being essentially a book of reference, the reviewer's task is an easy one, as the value of the work is best indicated by means of a short summary of its contents. Generally speaking, we may say that this volume deals with the theory of molecular radiation and those facts of spectroscopy which throw some light on the theory. The discussion therefore embraces the question of multiple spectra, the observed regularities in the spectra of bodies and the Zeeman effect.

The first chapter deals with the connection between emission and radiation. The early work of Balfour Stewart and of Kirchhoff, which had already been touched upon in the first volume from the historical side, is now discussed as regards its logical stringency. It is, perhaps, to be regretted that this chapter was written before Lord Rayleigh's defence of Stewart's proof had been published; but Kayser has added a footnote in which he quotes Rayleigh's opinion, having already given in the text the verbal transcription of the passage in Stewart's writing on which his claim to independent and previous discovery of the fundamental law of spectroscopy rests, so that every reader may form his own judgment.

The paragraphs dealing with the experimental verification of the relation between absorption and radiation are of considerable interest, and reveal the great need of further work in this direction. No one doubts the accuracy of the theoretical law in he case for which it applies, which is that of thermic equilibrium. But experimental investigation of the absorption in flames and Geissler tubes is very likely to throw some fresh light on the mechanism of luminescence due to chemical or electric action. The results of Gouy's investigation are sufficiently curious to render their repetition and extension desirable.

The second chapter, which treats of the radiation of solid bodies, is a most valuable and complete summary of our knowledge of the radiation of hot solids, first as regards their total radiation, leading up to Stefan's law, and secondly as to the partition of the total energy into its elementary portions depending on wave-length. Great progress has recently been made in our knowledge of the emission of black bodies, but the radiative properties of gases, dealt with in the third chapter, present greater difficulties. In the first place, we are not able experimentally to render a gas luminous by a purely thermal process, and it is well known that some writers have gone so far as to assert that a purely thermal radiation cannot give a discontinuous spectrum. There is no doubt that such a view would get over some theoretical difficulties, but at present the facts seem against it. At any rate, so far as experiments go, the relation of radiation to absorption has not been found to be materially different in the flame and in the arc than it is in a body which is in thermal equilibrium. We may mention in this connection an observation of Gunther quoted by Kayser (p. 182), in which sodium rendered luminous in a Bunsen flame shows absorption lines when the light from a platinum wire made incandescent in the same flame is sent through it.

The question of the mechanics of radiation is at present in a state of transition, the electron theory rapidly gaining ground. A certain inequality of treatment in this respect in different parts of the book could not be avoided, but the modern theory is not neglected, though not pressed forward with that sympathy which some might perhaps have wished.

One small matter I should like to set right. Prof. Kayser quotes me as supporting E. Wiedemann's calorimetric measurement of the heat necessary to dissociate the molecule of hydrogen into its constituent atoms. I was indeed surprised to find, on looking up the reference given by Kayser, how strongly I had expressed myself in this respect, a few months after Wiedemann's paper had appeared. I have long since become convinced that the experiments were inconclusive, and I therefore quite agree with Kayser's own views on the subject.

The questions relating to the variability of spectra, including the effects of pressure, temperature and mode of incandescence, are fully discussed in the fourth and fifth chapters.

Our knowledge of the influence of the various forms of electric discharge and the different modes of producing incandescence is gradually becoming more complete, but there is still considerable difference of opinion as to the interpretation of the facts. The additional lines which, *e.g.*, are introduced into the spectra of metals when a Leyden is introduced into the discharge of an induction coil may be interpreted as due to an increase of temperature merely, or as due to some peculiarity of the form of discharge.

The general opinion of spectroscopists, towards which Prof. Kayser seems also to lean, is that there are effects which may be peculiar to the method of discharge and cannot be explained by mere changes of temperature; but, on the other hand, all classifications of star spectra are more or less based on the supposition that the temperature is the chief, if not the only, cause of the differences observed. Little has been done of late years to obtain a direct answer to the question whether a spectrum is completely defined by temperature and pressure without reference to electrical effects. If we limit ourselves to temperatures not higher than that of the electric arc or the oscillatory discharge obtained by means of a condenser and self-induction, experimental evidence seems to show that the method of producing incandescence is immaterial. At any rate, identical spectra may be obtained (*a*) in an electric arc produced by a constant current, (*b*) by an oscillatory discharge from metallic poles, (*c*) in the cone of a Bunsen burner. At present there seems, therefore, no reason to suppose that high temperature is not in itself sufficient to produce all the effects observed when incandescence is produced by a high-tension spark.

Some of the older researches, which were carried out at temperatures sufficiently low to admit of measurement or approximate estimation, might with advantage be repeated or extended. It is now generally admitted that

differences in spectra such as that indicated by a change from a band to a line spectrum are due to changes in molecular complexity, but one would like to see at least one case worked out in detail. The change from the band spectrum of sodium to the spectrum of lines probably takes place simultaneously with the splitting up of the molecule containing two atoms, but this has never been clearly proved. A single example of this character thoroughly investigated would set many conscientious doubts at rest. When we further consider gases which show much greater variability, such as oxygen, which has seven undoubted different spectra, not counting subdivisions, justifiable speculation is obliged to go still further ahead of experimental demonstration. All things are possible in a vacuum tube, but all the same it would be more satisfactory to know exactly what takes place.

To explain the difference in spectra observed in different circumstances, we have the choice between molecular dissociations and molecular associations, and I should like to suggest one further possible cause of variability. We cannot doubt at present that it is possible to separate an electron from matter, and it is possible to imagine that an atom may under electric influence have on its surface one electron less or one electron more than it possesses in its normal condition. Such an increase or diminution would doubtless have a very material effect on the radiations which the atom can emit. Possibly the peculiar spectra which are seen in the glow surrounding the negative pole of a vacuum tube may be due to the association of an ordinary molecule with the originally free electron projected from the kathode.

There is an interesting short chapter on the appearance of spectrum lines, and Doppler's principle is discussed at length (nearly one hundred pages) by Dr. H. Konen.

We can only say a few words about the two last chapters, yet they are perhaps the most important portions of the book. In chapter viii. the relationships discovered between the wave-lengths of lines belonging to the same spectrum are discussed. Every reader of this notice knows how much science owes to Prof. Kayser in this portion of the subject and will give special weight to his exposition of it. The structures of the so-called fluted bands have not, perhaps, attracted the same amount of attention as the regularities found in the component lines of a "series" spectrum. The large number of lines which make up a band may give larger possibility of accidental coincidences, but the subject is one which well deserves the attention of those who wish to advance the mechanics of molecular structure. It is needless to say that the series laws are fully discussed, as well as the relationships so far found between the spectra of different elements.

The last chapter, which deals with vibrations in the magnetic field, is written by Prof. Runge. It is full of interest, not only on account of the complete statement of the facts so far as they are known at present, but also on account of the clear exposition of the theoretical discussions by Lorentz and others, Prof. Runge himself adding important contributions to it. Zeeman's discovery has been remarkably fruitful in dividing spectral lines into groups which seem intimately connected with each other, and the subject is far from being exhausted. The insensibility of band spectra to magnetic influence is probably connected with their insensibility to the effects of pressure, and seems to point to a materially different origin of the two classes of spectra.

Prof. Kayser may congratulate himself on the successful completion of this volume, which is full of suggestive criticism. Its value is enhanced by the fact that it brings the gaps in our knowledge prominently before us. Anyone wishing to advance by original research a science which is destined to clear up the secrets of molecular and atomic constitution will find Prof. Kayser's work full of promising starting points. ARTHUR SCHUSTER.

THE MAMMALS OF EGYPT.

The Zoology of Egypt—Mammalia. By the late J. Anderson. Revised and completed by W. E. de Winton. Pp. xvii + 373; illustrated. (London: Hugh Rees, Ltd., 1902.) Price 7 guineas net.

FOR many years previous to his untimely death, the late Dr. John Anderson devoted, with characteristic energy and enthusiasm, a large amount of time, labour and money to collecting the mammals of Egypt, with a view of publishing a fully illustrated description and revision of that section of the fauna of the country. And at his decease he left behind him the greater part of the manuscript for the present work, in a state verging more or less nearly on completion. It would have been a thousand pities had this labour been lost to zoological science; and Mrs. Anderson, who has herself written the preface, is entitled to the gratitude of all naturalists for her resolve that the work should be completed and published. No better memorial could indeed have been devised to perpetuate the memory of her late husband, of whom a life-like portrait is prefixed to the volume.

In the selection of Mr. de Winton to undertake the task of completion, and, where necessary, revision (for zoology is not a science that stands still), Mrs. Anderson has been thoroughly well advised, for that gentleman has for some years made the mammals of Africa a special study, in the course of which he has not only added considerably to the list of species and races, but has likewise made important contributions to our knowledge of the affinities and taxonomy of well-known forms. Without in any wise detracting from the work of the original author, it may be confidently stated that Mr. de Winton's task has been by no means an easy one, and he is to be congratulated on the manner in which he has carried it through. Certain sections of the work—notably those dealing with the shrews and the hares—are entirely the work of the editor, who has also rewritten certain other sections. Of many of the species and races recorded in the volume, he is also the first describer, although all such forms have been previously named in other publications; and with the exception of that of one race of striped polecat, no new names appear to be proposed in the book. It is highly satisfactory to learn that Mr. de Winton's labours have met with the thorough approval of Mrs. Anderson, who observes in the preface that the manner in which he has carried out his task will commend itself to zoologists generally.

A special feature of the book is formed by the fifty-five

coloured plates, all of which were drawn with great care by Mr. P. J. Smit from actual specimens, and are excellent representations of the species they portray. Special interest attaches to the reproductions of radiographs of the skeletons of three mummified baboons, as affording an instance of the author's thoroughness and perseverance. Finding that he could not obtain permission to remove the bandages from the mummies, Dr. Anderson called in the aid of the radiograph, and by this means was enabled in some instances to identify the species to which they belonged.

The mention of baboons reminds us that Dr. Anderson devoted an immense amount of labour and research to the elucidation of the complex synonymy of this puzzling group, and it is satisfactory to find that he has succeeded in clearing up several doubtful points, although others still remain for his successors.

The yellow baboon, commonly known as *Papio babuin*, he has identified with the *Simia cynocephalus* of Linnæus, and the species should consequently in future be known as *Papio cynocephalus*. If we understand him rightly, he regards the Abyssinian thoth baboon (*P. thoth*) as specifically inseparable from the former. Here we may venture to refer to what is, in our opinion, the one fault of the work, namely, its excessive verbosity, whereby it is sometimes by no means easy to arrive at the author's true meaning. A concise summary of conclusions at the end of each description, in which difficult questions are discussed at great length, would have been of inestimable value.

Several other emendations of current nomenclature occur in the course of the work, to a few of which special attention may be directed. For the wild cat of Egypt, commonly known as *Felis maniculata*, the earlier name *F. lybica* (or, correctly, *libyca* or *libica*)[1] is adopted, and it is important to notice that the so-called Kaffir cat of South Africa is regarded as nothing more than a local race of this species, under the name of *F. lybica obscura*. It may be suggested, however, that if this species be, as is commonly supposed, the progenitor of the domesticated cat of Europe, its proper title is *domestica* instead of *libyca*. That the use of a name originally applied to the domesticated representative of a species is not repugnant to the author and editor is proved by their employment of the name *asinus* instead of *taeniopus* for the wild ass of this part of Africa. Another change of more far-reaching import is the replacement of the name Dipus, in common use for the jerboas, by the earlier Jaculus, this change likewise involving the substitution of the family name Jaculidæ for the familiar Dipodidæ. Brief references may likewise be made to the replacement of the name *Halicore tabernaculi*, hitherto universally used for the Red Sea dugong, by *H. hemprichi*.

In regard to the nomenclature of the Canidæ, we notice that the fennecs and foxes are separated from the typical genus as Vulpes, whereas in a paper on the African members of that group, contributed in 1898 by Mr. de Winton to the Zoological Society's *Proceedings*, both groups are classed as Canis. We presume this is not a change of front on the part of the editor, but merely a desire not to interfere with the views of the original author.

In an earlier part of this review, we have had occasion to mention that zoology is not a stationary science. An exemplification of this is afforded by the fact that even on its publication the work under consideration is in one small detail out of date. In the text, it is considered that no distinction can be drawn between the northern and southern representatives of the African aard-wolf (*Proteles cristatus*). Mr. Rothschild, in a recent issue of *Novitates Zoologicae*, has shown, however, that three local races of this curious animal are distinguishable, namely, the large and fully striped typical Cape form, the more sparsely striped Angola race and a Somali race.

It may be added, in connection with taxonomy, that the author divides the bats into a much larger number of family groups than is the usual practice of naturalists, making the genus Noctilio the type of one family, Rhinopoma of a second and Molossus of a third.

Regarding the work as a whole, it may be safely said that not only is it an excellent and exhaustive account of the mammals of the area of which it specially treats, but that it is also a most valuable contribution to the study of mammals in general, its value in the broader sense just referred to being partly due to the character of the work itself and partly to the circumstance that Egypt forms a portion of the border-land between the Holarctic and Ethiopian regions, and thus presents a mixed fauna of more than ordinary interest. It is a subject of congratulation to all concerned that the authorities in Egypt have taken great interest in, and have done all in their power to assist the work, which will long remain the standard authority on the subject, and forms, as already stated, a worthy and lasting memorial of its learned and lamented author. R. L.

[1] In the case of this species, the author adopts the incorrect spelling of its original describer, whereas the Libyan striped polecat is termed *Ictonyx libyca*.

THE TERPENES.

The Chemistry of the Terpenes. By F. Heusler, Ph.D. Translated by F. J. Pond, M.A., Ph.D. Pp. xv + 457. (London: J. and A. Churchill, 1902.) Price 17s. net.

THIS work stands out as a monument to specialisation. A few years ago, the possibility of writing long memoirs upon any one branch of chemistry—especially organic chemistry—would have been out of the question, but to-day we are bombarded right and left with monographs upon this and that branch of chemical science. It is truly remarkable, considering the great array of books upon specialised subjects which are published in Germany, that publishers can be found willing to undertake the risk of bringing them out. But as the writing and publishing of these works goes on with unabated vigour, evidently they must find a sufficient circle of readers to make them a profitable investment, both from the point of view of the author and publisher. One rather wonders how it is that very few books on specialised subjects, which can to any extent be called exhaustive, are published in England. If we desire to study any special branch of science, we are bound either to go to the original publications or to consult foreign compilations

or translations of foreign works upon the subject. And again we may ask, Why is it that so many of the translations hail, not from this side of the water, but from America? The only possible reply seems to be that the scientific Englishman is not fond of writing.

The book under review, which has been translated by Dr. F. J. Pond, assistant professor in the State College of Pennsylvania, is dedicated by its author to Prof. Wallach. We are not surprised at this, because, owing to the careful and splendid experimental work of Prof. Wallach, the chemistry of the terpenes has become systematised and simplified (*i.e.* relatively simplified) in a manner which at one time seemed almost out of the question.

The book commences with an introduction of twelve pages. Naturally, the study of the camphors or oxidised compounds of the terpenes could not be left out of any work which dealt with the terpenes. Dr. Heusler explains that

"Japan camphor, while closely allied to the terpenes, has such an extremely large number of derivatives that an exhaustive description of them would demand as large a space as the derivatives of all the remaining members of the terpene group taken together."

Therefore Dr. Heusler only mentions those which are most closely related to the members of the terpene group. But at the same time, it would have been both interesting and instructive if he had seen his way—perhaps in the form of an appendix—to give a summarised discussion of some of the controversial points under consideration in the camphor problem. As it is, he only gives Bredt's formula for camphor and passes over the others, as he considers that the present state of our knowledge is scarcely sufficient to allow of criticism. If we take down the British Association notes for 1900 and study Dr. Lapworth's very able report upon the camphor question, we see that it is possible to summarise shortly the camphor literature in a lucid and satisfactory manner.

Under the heading "Hemiterpenes," there is a short description of isoprene and some of its derivatives. The connection of such vegetable products as guttapercha and the terpenes is noteworthy, isoprene being of special interest, since when acted upon by concentrated hydrochloric acid it polymerises into a rubber-like substance. On the other hand, isoprene, along with other substances, is produced when the vapour of turpentine is passed through a red-hot tube.

We then come to the study of the terpenes proper; this portion of the book occupies nearly one hundred pages. Naturally, pinene, the chief ingredient of turpentine oil and the most widely distributed of the terpenes, is first studied. Under each terpene, the preparation and properties are first given, and then their behaviour towards oxidising agents and various reagents.

Following the terpenes, we come, on p. 133, to the study of the oxidised compounds; this is divided into two parts —(1) Substances which cannot be regarded as derivatives of the hydrocymenes, analogues of pinene, camphene and fenchene; (2) substances which may be regarded as derivatives of the hydrocymenes. Camphor, which falls under the first category, is first discussed, and here again Bredt's formulæ for camphor, camphoric and camphoronic acid are given. The study of the olefinic members of the terpene series follows on p. 377; the first portion is devoted to the study of the hydrocarbons and the second part to the oxygenated compounds, such as linalool, geraniol, the pleasant-smelling constituent of Turkish and German oil of rose and citronellol. The last twenty pages are devoted to the study of the sesqui- and poly-terpenes.

Taking the book as a whole, it will be found to be a very interesting review of some of the most important work which has been carried out in connection with the chemistry of this very abstruse but exceedingly interesting branch of chemical science. At times there is a tendency to lapse into a "dictionary" style of writing, but it should be borne in mind that descriptive writing is of all writing the most difficult. The book should be of great value to all those who are engaged upon the study of the terpenes or of camphor, but when this work of 450 pages has been carefully studied, it will still be found necessary to consult the original literature. Fortunately, Dr. Heusler has given fairly full references, and for this he cannot be too highly commended.

The book can hardly be recommended to the general student, because he would be apt to lose himself in a maze of compounds a previous knowledge of which is taken for granted.

Dr. F. J. Pond has evidently taken great pains in translating the book, and he certainly deserves a word of thanks for his trouble. F. MOLLWO PERKIN.

EXPERIMENTAL PHONETICS.

The Elements of Experimental Phonetics. By Edward Wheeler Scripture. Pp. xvi + 627; 26 plates and 348 illustrations. (New York: C. Scribner's Sons; London: Edward Arnold, 1902.)

THIS handsome volume is one of a series of books issued by a number of the professors and instructors of Yale University in connection with the bicentennial anniversary of that institution. It is an effort to collect and arrange the data at present available concerning the voice in song and speech, and it is enriched by an account of much valuable work done in the field of experimental phonetics by the author himself.

During the last decade, the science of phonetics has made rapid progress, more especially in France, Germany, America and Scandinavia; it has now a nomenclature and methods of its own, and it is cultivated with much earnestness and ability by many workers, some of whom are a singular combination of physicist physiologist and philologist. The scope of the science is a study of the physical, physiological and psychical phenomena connected with language. It deals with the physical basis of the sounds of language, with the physiological mechanisms by which these sounds are produced, with the cerebral phenomena connected with the psychical processes that lie at the root of the nervous mechanisms by which ideas find expression in articulate sounds, and with the laws of emphasis and of rhythm.

In this work, Dr. Scripture surveys the whole field. He first of all deals with the physical aspect of the subject in a series of sections on the curves of speech—that is

to say, with the sound and speech curves produced by the phonautograph, phonograph and gramophone, and by the observation of the movements of vibrating flames, discs and membranes. He also describes in great detail the harmonic analysis of such curves. The next part of the work is devoted to the perception of speech, and here we find a full description of the ear, a discussion of the theories of hearing now so much debated, and, lastly, a detailed consideration of what may be termed the psychology of speech, such as the perception of speech elements, the nature of speech ideas, the laws of association, more especially the special associations of speech and the formation of such associations. Dr. Scripture rightly sees that the discussion of the nature of language must not be concerned only with the vibrations that constitute the sounds of words, or with the physiological mechanism of the articulating organs, but must take into account psychical phenomena associated therewith.

The following section deals with the production of speech, and here we find by far the most complete account that has yet been written of the action of the larynx and the movements of the tongue and pharynx. Most ingenious are the methods for determining tongue contacts, or the exact position of the tongue and soft palate in articulate speech. Here also the author treats of the tones of the vocal cavities in connection with the vexed question of the nature of vowels, and in general he supports the views of Prof. Hermann. Last of all, we have a section on the factors of speech, in which Dr. Scripture deals with vowels, consonants, melody, rhythm, accent, &c. There are three valuable appendices, the second of which, being studies of speech curves, shows magnified tracings taken by the author from gramophone records of certain admirable recitations. These tracings are by far the best that have yet been obtained, and they are carefully analysed as to varying amplitude or intensity, pitch, and period or frequency. When one looks at the long series of waves representing the sounds of spoken words, as shown in these tracings, the ultimate analysis seems almost hopeless, and more sure progress would be made if an analysis were carried out of very simple monosyllabic sounds, such as "pat," "bat," "cat," &c. Dr. Scripture also gives a table of phonetic symbols, and there is an excellent index. There are full bibliographical references to the works of all who have contributed to experimental phonetics, and the only name we miss is that of Dr. Marage, of Paris, whose recent researches are of much interest and value were it only for the fact that he has succeeded in placing the theory of vowel tones in a concrete and simple form.

It is not easy to find fault with such a work as we are considering, which, in the way of thoroughness and clearness of exposition, may take its place alongside the "Sensations of Tone" of Helmholtz. An author must be allowed to work out his subject in his own way, and if we think certain parts, such as the description of the ear and of the larynx, and the phonetic discussion of sound fusion, might have been shortened, still Dr. Scripture may not be of the same opinion. We would also observe that in dealing with psychological phenomena (and the same fault may be found with some physiologists as to the language they use in describing nervous phenomena) there is a tendency to make use of expressions which have a definite meaning in physics, but when applied to other phenomena they are words, mere words. Thus, at the beginning of chapter x., on speech ideas, we have the following sentences:—

"The current of thought in consciousness varies in its density from moment to moment. The regions of less density may be used to divide off parts of greater density; such portions of greater density are what we usually term 'ideas' or 'thoughts.' Each denser portion of the speech current in consciousness is an 'auditory idea' or—as a matter of speech—a 'phonetic unit.'"

The use of the words "density" and "current" are liable to misconception; at all events, it does not appear to us that this mode of stating the case makes it any clearer. Altogether, however, this is a great book, and we congratulate the author on its production.

JOHN G. MCKENDRICK.

OUR BOOK SHELF.

Notions fondamentales de Chimie organique. By Prof. Ch. Moureu. Pp. 292. (Paris: Gauthier-Villars, 1902.) Price 7.50 francs.

THERE is nothing calling for special remark in this little compendium of organic chemistry. It belongs to a type of scientific literature with which we are thoroughly well acquainted in this country, and has been written for the use of elementary students as an introduction to this branch of the science. The six chapters deal respectively with preliminary theoretical notions, hydrocarbons, oxygen-containing compounds, nitrogenous compounds, organometallic compounds and heterocyclic compounds. This classification will be unfamiliar to English chemists, and although it may possess certain advantages, it necessarily results in the association of the most heterogeneous groups. With the exception of this arrangement, the work follows the usual course, and the subdivisions of the chapters bring out with sufficient clearness the family resemblances arising from similarity of chemical type. Of course, the great difficulty which all writers of these short manuals have to contend with is the compression of such an enormous range of subjects into a limited number of pages without distorting the perspective view of each branch. Every original worker —and M. Moureu's contributions to synthetical chemistry entitle him to a prominent position in this capacity— has a tendency, often quite unconsciously, to give undue prominence to his own branch of the subject or his own particular theoretical views, and this is a real danger from which the elementary student cannot be too carefully guarded. No fault can, however, be found with the work from this point of view, and the author has maintained a fairly uniform balance throughout. The short treatment of stereochemistry (12 pp.) is particularly lucid so far as it goes, although the author only leaves himself half a page for the stereochemistry of nitrogen and sulphur. On the whole, this manual, regarded as a descriptive treatise to be used in association with laboratory work and lecture-room attendance, may safely be commended to the class of students for whom it is written:—

"Ouvrir l'esprit de l'élève en l'initiant graduellement au mécanisme des transformations de la matière et en lui présentant les grandes lignes de la Science avec le relief qui leur convient, le préparer ainsi à suivre avec fruit un *Cours complet* et à faire un usage profitable des *Traités* proprement dits, tel a été notre but, notre unique objectif

en écrivant ce petit ouvrage, que nous considérons comme une *Introduction à l'étude de la Chimie organique*" (Preface).

How refreshing must it seem to teachers in this country to meet with an elementary work on chemistry containing no reference to the "Syllabus" of any Board of Examinations. R. M.

Penrose's Pictorial Annual, 1902-3. The Process Yearbook. An Illustrated Review of the Graphic Arts. Edited by William Gamble. Pp. xvi + 136 and 56. (London: A. W. Penrose and Co., Ltd., 1902.)

THE present issue of this very handsome and interesting year-book forms the eighth volume of this useful publication. Year by year the progress made in process work is here recorded, and at each issue the high standard of excellence of this book is raised. The rapid strides made in three-colour work and its general application to technical and artistic subjects render the present volume of especial interest, and the editor has brought together numerous articles and reproductions which will give the reader, not only a good insight into the principles involved, but a general idea of the excellence of the finished pictures.

As in former volumes, the engraver, printer, publisher, &c., have all apparently vied with each other to produce the best work, and an examination of the book down to the most minute detail shows how completely each has succeeded in his task. Printed on "perfection quality art printing" paper, the type in the text, and the illustrations, appear at their best, and in each case useful details, such as description of the original process employed, name of printer, &c., are added. The illustrations are representative of the application of process work to all types of subjects, from blocks for catalogue illustrations, such as cut-glass objects, silver work, machinery, &c., to others as reproductions of oil paintings, landscapes, portraits, birds' eggs, &c.

Although little has yet been said about the text, the articles on the various topics will be found full of useful and interesting facts and experiences. The book will be found a valuable addition, not only to the library of the amateur or professional photographer or process worker, but to those who wish to choose between different processes as judged by the finished examples. As a simple picture book, it should have many admirers.

The Zoological Record for 1901. Edited by D. Sharp. (London: Zoological Society, 1902.)

YEAR by year, this invaluable publication increases in bulk, the present volume being considerably thicker than the one for 1900, as the latter was larger than its predecessor. The task of the editor and his staff is indeed a prodigious one, and the marvel is how it is completed year by year within the allotted time. That shortcomings must occur here and there is, as the editor admits, inevitable, but all concerned are to be congratulated that they are so few and far between. At the conclusion of his preface, Dr. Sharp suggests that before many years elapse the "Zoological Record" may come to an end, owing to its place being filled by the "International Catalogue of Scientific Literature." Unless, however, the latter undertaking progresses at a more rapid pace than at present seems to be the case, naturalists will sadly miss the regular appearance of the well-known russet volume shortly before Christmas, and it would be a thousand pities if the publication were discontinued before it became absolutely superfluous. Except a certain lack of uniformity between the different sections, to which we have called attention on a previous occasion, the volume before us is so carefully edited as to call for nothing in the way of criticism.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Biology in Universities.

IN connection with an editorial article on university development at the beginning of your issue of January 1, where you quote a pamphlet of mine called "A Survey of the Sciences," drawn up for the information of Governors of the University of Birmingham, I have received a contribution to the subject from Prof. Herdman, emphasising the separate inclusion of Biology in addition to the specific sciences of Zoology and Botany, and especially emphasising its vital importance in the scientific study of Medicine.

I would ask you, therefore, to print it as the opinion of a highly competent specialist. OLIVER LODGE.

IN NATURE of January 1, p. 193, right-hand column, middle, between ARCHÆOLOGY and BOTANY, I should like to have seen:—

BIOLOGY:—The fundamental science of medicine—which may, in fact, be regarded as applied experimental biology.

It is, therefore, an essential part of the preliminary training of every medical student.

It is the central, or basal, area of the natural sciences, containing, as it does, the facts and principles which are common to, and undergo application and further elaboration in, the sciences zoology, botany, anatomy, physiology, pathology, bacteriology, anthropology, psychology and palæontology.

It is (or should be), moreover, a subject of general culture, with many interesting applications to ordinary everyday life; and is of primary importance in philosophy both on account of its historic connection with the work of Darwin, Herbert Spencer and Huxley—biologico-philosophic work the influence of which, not only upon science, but also upon many other departments of thought it is difficult to estimate—and also because of more recent developments in connection with heredity, reproduction, &c.

All this on the pure science or educational side. In its practical applications, biology has an enormous field before it in the future in connection with arts and industries, our food supplies, fisheries, drainage and the metabolism of the ocean—matters affecting the health of man and the prosperity of the country.

Some of these points were referred to under zoology or botany, but there is so much ground common to these two sciences, and they are so interwoven both in matters of theory and in practical applications, that it is desirable to recognise these relations under the heading biology.

W. A. HERDMAN.

University College, Liverpool, January 2.

Genius and the Struggle for Existence.

IF the struggle for existence and survival of the fittest mean anything at all, they surely mean that any quality which is useful to the individual, or race, will be preserved and increased. Sir Oliver Lodge, however, in his "Survey of the Sciences," as reported in NATURE, January 1, says:—

"The struggle for existence, though doubtless a stimulating training for the hardier and sturdy virtues, is not the right atmosphere for the delicate plant called genius."

But if genius is not evolved in the struggle for existence, then it is not an advantage. In the usual phraseology of natural selection, it is considered enough to say, "Such and such a quality, or organ, is useful, *therefore* it will be evolved in the struggle for existence."

If, then, Sir Oliver Lodge is right, either (1) genius is not useful, or (2) useful qualities are not—necessarily—evolved in the struggle for existence.

And if genius is—which I take leave to doubt—the tender greenhouse plant represented by Sir Oliver Lodge, is it worth while trying to preserve it in this—more than—bracing environment we call life? So far as I can gather from the figures given, the education of *one* whose discoveries will be of

"incalculable value" involves the education on similar lines of 9999 who will not be of any special value.

13 Vicarage Drive, Eastbourne. G. W. BULMAN.

YOUR correspondent, like many other people, regards the struggle for existence, not only as a fact, but as an ideal; not only as a necessary mode of effecting improvements in low-grade organisms, but as a method which should indefinitely continue in unchecked and unaided action, in spite of the arrival on the scene of a comprehending and guiding intelligence, such as may be competent to replace it by methods more direct and rapid; for instance, the methods of artificial selection and protection of the weak, which we have learnt how to begin to practice.

He also presses his admiration for the struggle-and-survival method so far as to suppose that no properties and powers can be useful which are not fostered by it.

To me it seems that struggle and competition are more akin to those forces of nature which the human race does wisely to train and hold in check, as a maritime country might protect its coasts from the ravages of the sea, instead of sitting idle and assuming that nature alone, without the guiding hand of man, is perfect and unimprovable. Surely it is a mistake to suppose that the fostering care which after long effort has been now manifestly introduced into the scheme is useless and inoperative and subordinate to the forces which preceded it.

OLIVER LODGE.

A Pot of Basil.

MR. A. E. SHIPLEY's interesting article (p. 205) on *Ocimum viride* and its influence on mosquitoes recalled some observations that I made upon the papaw-tree (*Carica papaia*) in China. My house, on the bank of the river at Whampoa, near Canton, was singularly free from mosquitoes, though the other houses on the same island were more or less infested with them. A line of papaw-trees stretched between my house and the river. I frequently watched these trees, yet I never saw a single insect alight on them, though flies and other insects settled in numbers upon the bamboos and banana-plants not far away. In fact, the papaw-trees seemed to keep insects at a distance and to act as a rampart guarding the house from mosquitoes. The probability of this suggestion was considerably strengthened by the increase in the number of mosquitoes entering the house after a typhoon had blown down two papaw-trees and thus made a gap in the row, and by the still further increase when a second typhoon felled another of the trees. I have questioned a number of persons living in the tropics, and one of them stated that he was familiar with the fact that papaw-trees repelled mosquitoes.

That the papaw-tree possesses some curious property—in addition to the notorious proteolytic action of its juice—is suggested by the widespread practice of hanging meat in its shade to render the meat tender. The custom is frequently regarded as a senseless one, but its wide distribution causes one to ask, Is it not possible that the papaw-tree should exhale a gaseous product which either repels meat-destroying insects or exerts an antiseptic action on putrefactive bacteria, or, finally, is a volatile ferment? The peculiar relation in regard to temperature displayed by the proteolytic ferment of the papaw juice renders the last possibility less improbable than at first impression.

PERCY GROOM.

The Mismanagement of London University Library.

Is it impossible for the powers that be at London University to abolish the scandalous regulations concerning the library, and to render this library a means of culture instead of an almost unusable and unused collection of books? A university library ought to be so managed that anyone wishing to bequeath books could put them to no better use than by leaving them to the university; but, as things are, it would scarcely be possible to more effectually *waste* books than by giving them to London University. In the first place—contrary to the practice of the learned societies and the subscription-libraries—no graduate is allowed to have books sent to him by post, which regulation at once renders the library utterly useless to the great majority of graduates. Secondly, an absolutely insane rule requires the return of all books by December 31 of each year, even though they may have been borrowed at Christmas and are required for study during the vacation! and although I interpret this rule as applying only to non-members of Convocation, a contrary interpretation has prevented me from obtaining books a fortnight ago. Thirdly, although the University has now been located in its new home for two years, a personal demand for books is met by the reply that, as "the books of the library have not yet been arranged, and the whole library is in a very disorganised state," the books either cannot be found at all or only after several days' delay! The history of a recent attempt to obtain books from this library would move the careless to laughter and the studious to anger; but I dare not trespass further on your space. F. H. PERRY-COSTE.

Polperro, R.S.O., Cornwall, January 8.

Recent Earthquakes in Guatemala.

A FEW weeks ago, I returned from a journey of several months' duration through the western part of the republic of Guatemala, where I investigated, at the request of the Government, the causes and effects of the recent earthquakes. The principal results are the following:—

The first severe earthquake was reported to have occurred on January 16, 1902, at the south-west of Mexico, destroying Chipalzingo, the capital of the State of Guerrero.

On January 18, 5.20 p.m., a strong shock occurred on the Pacific side of Mexico and Guatemala, shaking down in the latter country the village of San Francisco Zapotitlan (near Mazatenango), and destroying buildings and masonry work in several large plantations near this village and farther west in a district south-east of the town of San Marcos. The shock came from the S.S.W., and was reported from the whole Pacific coast of Guatemala and Soconusco, but I could not get information how far inland it was perceived.

From that time on, a great many local shocks were noted in the western part of Guatemala, especially in a district called Costa Cuca.

At 8.25 p.m., April 18, the most severe earthquake occurred, being felt from Nicaragua to the city of Mexico, over all Chiapas, the whole republic of Guatemala, British Honduras and a great part of Spanish Honduras.

In my sketch (NATURE, June 12, 1902), the region in which most destructive effects occurred must be extended more to the west, taking in north-eastern Soconusco.

In Guatemala, the towns that suffered most were Quezaltenango, San Juan Ostuncalco, San Pedro Sacatepequez, San Marcos and the Port of Ocós. Great was also the damage done in the numerous coffee plantations. Enormous landslips dammed up rivers (Rio Naranjo and Rio Ixtacapa) and destroyed hundreds of thousands of coffee-trees. The total loss of human life numbered 330 to 335, of which 129 were killed in Quezaltenango and forty-nine in San Pedro Sacatepequez.

The earthquake lasted more than fifty seconds and also came from the S.S.W. This was clearly shown by the effects of the shock in the coast towns and in the coffee region; in Quezaltenango and San Marcos, there have been movements in many directions, but the initial one was also from S.S.W.

After April 18, a great number of smaller shocks of short duration and generally very restricted extension were observed, most of them again in the Costa Cuca and neighbouring districts, and on September 23 another larger earthquake shook the whole country again, but did little damage (in Quezaltenango a child was killed by a falling wall). I was then in Guatemala City, where the shock lasted sixty-five seconds. The movement was again from S.S.W. Reports about it came from the Peten, Belize, Salvador and Chiapas.

The epicentrum of the great earthquakes of January 18, April 18 and September 23 must be situated out in the Pacific Ocean; the cable which connects San José de Guatemala with the Mexican port Salina Cruz was broken during October.

The local shocks (of which I noted a great many) between the large ones came from different directions. Underground noises were frequent.

There had been wild reports about threatening eruptions or the Fajumulco Volcano (4210 m.), the highest in Central America. I ascended it in June and went around it at its base, but the volcano was quiet. Great land and rock slides had altered its slopes a little, especially to the south and around the crater. The hot springs at the town of Fajumulco were nearly in the same condition as when I had seen them in 1885.

The people of the district were also much afraid of the volcano of Santa Maria. This volcano, 3768 m. high, is in its upper

part a nearly perfect truncated cone. All sign of a crater has disappeared, the top being flat. There is no notice, not even tradition, about any eruption of the Santa Maria in pre-Columbian or historic time.

Between this volcano and the town of Quezaltenango, to the north-east, rises the volcano Cerro Quemada (burned mountain) to 3179 m., indicating a secondary fissure nearly at a right-angle to the primary volcanic fissure of Guatemala. The Cerro Quemada has a very large crater, difficult to go over on account of the big lava-boulders filling its bottom. No channel connecting with the interior of the earth is visible, but many solfataras and fumaroles exist there; they did not show any sign of renewed activity. The Cerro Quemada had its last eruption at the beginning of last century.

The deep-cut and narrow valley of the River Samalá separates these two volcanoes, Cerro Quemada and Santa Maria, eastward from the old volcano Zuñil. In the bottom of this valley, there are, near the Indian town of Almolonga, hot springs (their water had been reduced in quantity after April 18), and farther down, below the town of Zuñil, a great many fumaroles send up hot steam, and some of them show sometimes geyser-like phenomena, throwing out at intervals plenty of hot water to a height of a few feet. During the rainy season (May to October), these fumaroles produce more steam, and there is also a marked increase of their activity from the forenoon maximum of barometric pressure to the afternoon minimum.

To the north-west of the volcano Santa Maria rises the much more voluminous mountain mass of Siete Orejas (seven ears), 3361 m. high. It is a very old volcano; the upper part has disappeared and the disintegrating influences of water and air have carved out on its top a number of rounded eminences; deep barrancos cut its sides. On its southern slope, towards the Costa Cuca, exists a pretty large parasitic crater with a lake of about ½ km. diameter in it, called Chicabal. It has not yet been mentioned anywhere before.

The southern slopes of Siete Orejas and Santa Maria are separated by the barranco of the River Ocosito, which also separates the coffee districts of "Costa Cuca" and "Xoluitz." To the east of Xoluitz follows the district of "El Palmar." The highest coffee plantations here were Helvetia, San Antonio and La Sabina (1150 m.), the last one also a very popular bathing resort, with strong springs of mineral water (carbonic acid).

The region from the Costa Cuca to El Palmar was the most famous coffee district of Guatemala. Its annual production was from 250,000 to 300,000 quintals, and its plantations were provided with the best machinery and gave employment to about 40,000 labourers.

A great part of this prosperous region has been nearly annihilated by a volcanic outburst at the south-west side of the volcano Santa Maria.

Soon after midnight of October 24-25, terrific detonations announced the beginning of the volcanic activity (N.N.W. of El Palmar and at about 1800 m. elevation above sea level). These explosions were heard so far as the capital of El Salvador, over a great part of Chiapas and in the western part of Spanish Honduras. Here, near Gualan, I am about 150 km. in a straight line from the Santa Maria, but was awakened at 1 a.m. by the noise of explosions like cannon shooting at short distance. Towards morning, the louder detonations were repeated at longer intervals, but between them a nearly constant low roar could be heard. All noise ceased at about 1.30 p.m., but began again at 6 p.m. and lasted until 11.30 p.m. During the following three days, I heard detonations at different intervals.

The new volcanic vent began pouring out an immense quantity of ashes, sand and pumice-stone. The prevailing north and north-easterly winds spread the lighter material in a dense veil to the west and south-west, producing so far as Tapachula in Soconusco darkness for more than forty-eight hours. Ashes, sand and small stones fell in quantity over a large area, crushing houses, burying the vegetation, and a great many people perished. In the town of Quezaltenango (24,000 inhabitants), although the quantity of ash falling was not very dangerous, people got nervous about the terrific roar and afraid about the strong sulphurous smell, and thousands left the place. A great exodus began from the whole affected district, although heavy rains which accompanied the eruptions had swollen the rivers and destroyed every bridge. All the labourers, mostly Indians from the highland towns, ran away, but many perished under the falling ashes or were drowned in the rivers. The plantations nearest to the new crater are covered by a layer of stones and ashes 5 m. to 10 m. deep. Farther away, of course, less material fell, but still the damage done is very great. This year's coffee harvest there is completely lost (more than 200,000 quintals), and it will be very difficult to get the labourers back again to begin work to save what can be saved still.

Until a few days ago, it has been very difficult for me to get any exact information about this eruption. Dr. Carl Sapper, who arrived in Guatemala City on October 24, went afterwards to Quezaltenango. He writes me that he tried to get near the focus of eruptions, but the ashes and the sulphuretted hydrogen impregnating the air obliged him to turn back, and he could not get even a look at the new crater. In the Indian town of San Martin Chileverde, fifty-six persons killed had been buried, but as many huts are still under the ashes, more corpses will be found later. From some other places, he reports forty-eight lives lost, but the list is very incomplete.

Dr. H. Prowe writes me under date November 15 from Chocolá:—"The eruption is going on with frequent strong earthquakes, but the quantity of ejected material is diminishing greatly. The number of people who perished cannot be estimated yet, but more were killed now than by the earthquake on April 18. The new volcanic cone can be seen from San Felipe. It has an elliptic crater three miles by one mile (?) diameter."

For several years, the volcano Izalco, in El Salvador, the most active in Central America, had been very quiet. After April 18, it began its eruptions again, sending also forth a lava stream towards south-east, which nearly filled up a barranco between the volcano and the town of Izalco.

During last May, the volcano Momotombo, in Nicaragua, had a short eruption; now comes from the same country a report about the volcano Masaya being active. Dr. Sapper, who will leave San José de Guatemala on December 11 for Panamá and the West Indian Islands, intends stopping at Nicaragua to investigate these eruptions.

EDWIN ROCKSTROH.

Gualan, Guatemala, C.A., November 30, 1902.

PROF. LORENZ'S TREATMENT OF CONGENITAL DISLOCATION OF THE HIPS.

ON Wednesday, January 14, at the City Orthopædic Hospital, Prof. A. Lorenz, of Vienna, demonstrated his "bloodless" method of reduction of congenital dislocation of the hips. Before giving details of the demonstration, it may be desirable to describe plainly the nature of the affection.

Children are sometimes born with one or both hip-joints dislocated, the head of the thigh-bone being displaced either above and behind or above and in front of its socket, and sometimes in other directions. The parts of the bones forming the joint may be perfectly, or almost perfectly, formed, but are more often defective in shape; the head of the thigh-bone, instead of being a rounded projection, may be in the form of an irregular cone, and the neck of the bone, which should unite it to the shaft, may be shortened or absent. The socket in which this head should work—it is a ball and socket joint—is generally more shallow than is natural, and is very frequently deficient at its margins, especially posteriorly and above. Consequently, should it be possible to get the head back to its place, there is a great tendency to redisplacement.

It has always been the aim of those surgeons who especially study such cases (orthopædic surgeons) to retard, or arrest, or correct the deformity. It is impossible here to give the history of the surgery of this affection. It dates from the time of Hippocrates, but it was in the early part of the last century that surgeons, such as Dupuytren, Guérin and Pravez, described the affection scientifically and explained practical methods for treatin it. Pravez, jun., seems to have carried out treatment upon much the same lines as those now adopted by Lorenz, and several orthopædic surgeons in this country have, since then, followed the same plan

with more or less success. Buckminster Brown in America, William Adams, Noble Smith and others in England, have published cases in which they have been successful, not only in reducing the deformity, but in producing a permanent cure. The chief difficulty has always been the retention of the head of the bone in its normal position after reduction, and, in some of the cases so reduced, a relapse is said to have occurred. The less defective the joints, the better the prospect of success. Noble Smith recorded in the *British Medical Journal*, November 6, 1897, the case of a girl, aged six, whose left leg was affected and was two inches short in walking, but which was brought down by extension to a normal position in about three months. The patient was kept from bearing any weight on the affected limb for two years, and was then dismissed as cured. Three years later she was well, and walked perfectly, with so trifling a shortness of the limb that it was not noticeable.

Prof. Lorenz has, it seems, perfected this method of treatment. In double displacement, when the children are not more than seven years of age, and in single displacement up to the age of nine, he effects immediate reduction. He forcibly tears the contracted adductor muscles (in which operation he effects the division by manipulating and chopping the muscle with his hand), he then flexes the thigh on the body in order to stretch or tear the posterior muscles, and he extends the leg backwards in order to do the same to the anterior muscles. By these means he so loosens the joint that, by manipulation with the thigh flexed and abducted, he rotates the head of the femur into the depression of the acetabulum. He then forcibly abducts the limb in order to enlarge the anterior part of the capsule of the joint, and fixes the limb in this position. This fixation is, perhaps, the most important part of his treatment, from the demonstration of which the few English surgeons who had previously tried to follow out Dr. Lorenz's methods have learned much.

The tendency to redisplacement of the head of the femur backwards and upwards is counteracted by the extreme abduction and outward extension of the thighs. Thus the thigh, or thighs, are held out at right angles to the body to prevent displacement upwards, and they are held more backwards than forwards to prevent displacement of the heads of the femora backwards. This position is maintained by plaster of Paris bandages encircling the pelvis and extending to just above the knees. In a few days, the child is allowed to walk in its enforced squatting position. This she—most cases are girls—can do by supporting herself with a stick held by both hands in front, or she can be seated on a stool with castors and move herself about the floor. Lorenz has found it necessary to keep up this position for six months, then to bring down the thighs to a less angular position with regard to the body, so that the child can walk more easily, while, at the same time, the heads of the femora still press inwards and help to produce stability of the joint. The whole treatment must last for two years, and this length of time has been found necessary by surgeons in the past. In older patients, Lorenz advocates preparation by continued extension and, if necessary, by division of muscles, and in all cases this preparation is helpful.

The word "bloodless" is applied to this treatment merely in comparison to the operation of opening the joint in order to replace the head of the bone. It does not indicate the slightest opposition to the use of the knife when such is desirable.

Whatever may be the view of the surgeons of general hospitals, there seems to be no doubt among the leading orthopædic surgeons, such as Mr. Robert Jones, of Liverpool, and Mr. Noble Smith and his colleagues at the City Orthopædic Hospital in London, that the treatment so ably advocated and perfected by Prof. Lorenz is, at the present moment, the most satisfactory means known for dealing with these deformities.

The objections raised by these surgeons to the "open" method are :—(1) That it is a very severe operation and dangerous to life ; (2) that the results often lead to ankylosis of the joints operated on. One stiff joint may be sustained with comparative impunity, but if two stiff joints should occur, sad, indeed, is the condition of the patient, for walking is for ever after impossible.

The accidents which Prof. Lorenz so outspokenly referred to as having happened to him in first trying his bloodless method are matters of the past, and he asserted that, with due care on the part of the surgeon, such accidents ought never to occur again.

THE EGYPTIAN MEDICAL CONGRESS.

THE increased interest which is now being taken in the diseases of warm climates was clearly shown at the medical congress held in Cairo last month. Egypt, the recognised home of epidemics in the past, is the victim of many plagues to-day which constitute it an excellent field for medical study ; and the proceedings of the congress bore ample testimony to the scientific importance of the research work which is being diligently carried on in the valley of the Nile.

Out of a large mass of communications read before the meetings, we may select as worthy of special notice the papers on cholera, and the account of recent discoveries in connection with the Bilharzia and Ankylostomum parasites.

The reports on the late outbreak of cholera showed what admirable results had attended the work of the sanitary authorities. The enlightened and up-to-date methods now employed by them in combating the epidemic stand out in strong contrast to the misdirected efforts of their predecessors. Nowhere can we see more clearly the practical benefits which have been conferred on mankind by modern progress in bacteriological science. It is now incontestably established that cholera is spread by the infected water of the Nile and by the wells and drinking-fountains in the mosques to which the natives have common access, and the measures of the sanitary authorities are mainly directed towards preserving the purity of drinking-water as the best defence against epidemics. A general opinion now prevails, founded on the latest reports, that internal supervision and hygienic measures are of more value than quarantine regulations, which so often prove ineffective, and such measures are becoming increasingly important on account of the growth of population and crowded condition of the big towns. One great difficulty still remains—the problem of educating the natives up to the reforms which are being introduced for their benefit. Their ignorance of the elementary laws of health, combined with an innate indifference, still constitutes the main obstacle with which the authorities have to contend. At the same time, the recent epidemic would never have been dealt with so successfully if there had not been a growing enlightenment among the lower classes and a readiness to cooperate with the Government in its work of sanitary reform.

The scientific importance of Prof. Looss's papers on Bilharzia and Ankylostomum, particularly for students of tropical diseases, can hardly be overestimated. The diseases produced by these parasitic worms work the most terrible havoc among the native population of Egypt, and attempts have been made for some time past to find out by what means these parasites enter the human system and lodge in the intestine. The story of Prof. Looss's remarkable discovery is of the greatest interest. While making some experiments in the cultivation of ankylostomum worms, he accidentally allowed a drop of

water containing a number of these larvæ to rest on his hand. In a few minutes, a slight irritation set in which attracted his attention, but on examining his hand under a lens he found that the larvæ had disappeared. His conviction that they had forced their way through the skin into the subcutaneous tissues was confirmed at a later date, when he discovered that his intestine contained the ova of the parasite and that he had thus infected himself with ankylostomiasis. At the time, many persons were inclined to doubt his explanation of the occurrence, but he has since then made experiments with dogs and human beings, and in each case has been able to prove that the larvæ, entering the body by the skin, have worked their way into the intestine.

His study of the Bilharzia parasite has not yet reached the same stage of advancement, but although he cannot at present demonstrate the fact, he is convinced that the mode of infection is by the skin, as in the case of ankylostomum, and not by the mouth, as has been supposed. The negative evidence in support of this theory is that if the larvæ of Bilharzia are brought even momentarily into contact with weak solutions containing acids they are at once killed, and this fact renders it impossible for them to pass the stomach if they are taken by the mouth. Positive evidence is still wanting, owing to the great danger involved.

Prof. Looss has not felt justified in making experiments on human beings until a more perfect knowledge of the larvæ is attained, and it is difficult to find animals with a skin resembling that of human beings for the purposes of experiment. But from some partial successes he has had, he considers it only a matter of time before his contention will be established, namely, that healthy persons can become infected with bilharzia merely by dipping a hand or foot into water containing larvæ. When we consider how much of their time the natives spend in wading in the Nile and in the canals, the water of which contains these parasites, we are at last within measurable distance of accounting for the extraordinary prevalence of the disease among them.

THE VACCINATION ACTS.

THERE seems good reason to hope that the legal obligation of parents to procure the primary vaccination of their children in infancy will be extended in the ensuing session of Parliament so as to include revaccination at about twelve years of age. The widely representative and weighty deputation of the Imperial Vaccination League which interviewed the President of the Local Government Board last week made out a strong case for this and other amendments of the present law as to vaccination, and they had a most sympathetic reception from Mr. Long. He, of course, spoke only for himself, and not [for the Government as a whole, but being the head of the Board which has charge of the subject, and having evidently given it most careful consideration and arrived at pretty definite conclusions as to the main points requiring attention in a new Act, there seems every reasonable prospect that these conclusions will be found embodied in a Bill and submitted to Parliament in time for enactment before the session ends. It must be recollected that the question comes up this session in any case. The Act of 1898, which introduced domiciliary vaccination and the Conscience Clause, is only a temporary measure, ceasing to have effect after the end of the present year. There is no chance of its being allowed to drop so as to cause reversion to the old system, and very little chance of its simply being included in the Expiring Laws Continuance Bill. When they are at it, therefore, it is important that Government should deal with the matter with some degree of finality. The five years' experiment has been most useful in furnishing experience of the strong and weak points of the present law, so that the whole subject is ripe for legislative treatment. The aim should be to achieve, as nearly as possible, German results by English methods, and the chief points requiring attention are obligatory revaccination, the supply of glycerinated calf lymph, the adoption of a standard of efficiency of vaccination, and the transference of the administration of the Vaccination Acts from Boards of Guardians to public bodies better adapted for the work.

REV. DR. H. W. WATSON, F.R.S.

THE death, on January 11, of the Rev. H. W. Watson, Sc.D., F.R.S., has removed from the scientific world a worker who did much to elucidate one of the most difficult applications of mathematical reasoning to molecular science.

Henry William Watson was born in London in February, 1827, being the son of the late Thomas Watson, of the Royal Navy. At the age of nineteen, he gained the first mathematical scholarship at King's College, London, and two years later obtained a scholarship at Trinity College, Cambridge, where he graduated in 1850 as second wrangler and Smith's prizeman, Dr. Besant being senior wrangler. In 1851, he was elected fellow and assistant tutor of Trinity College, Cambridge, but on his marriage he was compelled by the then existing statutes to seek a livelihood elsewhere, and accordingly he obtained a mathematical mastership at the City of London School in 1854, and was appointed mathematical lecturer at King's College, London, in 1856 and assistant master at Harrow School in 1857. His work as a teacher ended after his appointment to the rectory of Berkeswell, near Coventry, where he resided until within a short time of his death. He was elected Fellow of the Royal Society in 1881.

A considerable proportion of Dr. Watson's published work was written with the collaboration of Mr. S. H. Burbury, F.R.S. Among these joint writings, we notice the treatise on generalised coordinates applied to the kinetics of a material system, published in 1879, the article "Molecule" in the ninth edition of the "Encyclopædia Britannica" and the treatise on the mathematical theory of electricity and magnetism, of which the first volume ("Electrostatics") appeared in 1885 and the second in 1889. The appearance of the latter volume occurred at a somewhat critical period in the history of electromagnetism. It was Dr. Watson's hope to clear up many of the obscure points in the deductive reasoning on which Maxwell's theory of electromagnetism was based. The same task had been undertaken about the same time in Germany by Hertz, who had, however, sought to substantiate the theory on experimental grounds, and his demonstrations of electric oscillations, followed up by the work of Fitzgerald and Lodge, diverted attention from the mathematical treatment of the subject. Dr. Watson, on the other hand, found in the course of the work that many points in Maxwell's theory could not be established by deductive reasoning alone, but he has given remarkably elegant treatments of many of the problems in which this difficulty does not occur.

The books written by Dr. Watson alone include a treatise on geometry in Longmans' Text-books of Science Series (1871), but his best-known work was the collection of propositions on the kinetic theory of gases, which for many years served as a text-book on this subject. While the second edition of 1894 was still in preparation, a controversy arose as to the validity of the Boltzmann-Maxwell law, and an apparent exception had been suggested in the case of a system of lop-sided spheres. Dr. Watson, by his investigation of the corresponding problem for circular

discs, did much to elucidate the error in the investigation in question, and to establish the result that if the distribution of coordinates and momenta, which Gibbs now calls "canonical," exists at any instant, it will exist at all future instants. He also gave considerable attention to Boltzmann's minimum theorem, putting the proof into an elegant form.

The theory of errors was a favourite study of Dr. Watson's, and in February, 1891, he read an address before the Birmingham Philosophical Society on the subject. About the year 1894, he was appointed examiner in mathematics in the University of London, but before his term of office had expired, he was compelled to resign owing to a slight paralytic stroke. Recently, owing to ill health, he gave up the rectory of Berkeswell, and migrated to Brighton not long before his death.

Dr. Watson was a representative of the old school of physicists who relied on mathematical reasoning alone, an extreme which would at the present day be as far on one side of the happy mean as the modern experimentalist who builds up mere tables of numerical results is on the other. But his chief work was done at a time when "natural philosophy" meant applied mathematics and not experimental electricity. He was a valued friend to whom the present writer has on more than one occasion been deeply indebted for help and assistance in difficulties.

G. H. BRYAN

DR. H. E. SCHUNC , F.R.S.

BY the death of Dr. Edv d Schunck, the world has suffered the los of one of that small band of men of fortune who have devoted themselves to the study of science for it wn sake. Edward Schunck was born in Manchester on August 16, 1820, to which town his father, Martin Schunck, had a short time previously removed from Malta to found the business of Schunck, Mylius and Co. This, which was one of the first firms of export merchants started in Lancashire, afterwards became Schunck, Souchay and Co., and as business increased they acquired a dye works in Rochdale. As Martin Schunck was anxious that his son should eventually undertake the management of this works, he sent him to study chemistry under Liebig at Giessen, and at Berlin under Rose and Magnus, but eventually, after some years' trial, the son found that he did not care for the business, and decided to devote himself entirely to research work.

Schunck must, without doubt, be considered the most celebrated worker upon the natural colouring matters, for among these substances there is hardly one to which he has not contributed some fact of considerable importance. His elaborate investigation of madder, commenced in the 'forties and continued to 1894, constitutes an excellent example of the energy and patience which characterised him throughout the whole of his career. With our opportunities of to-day, it is not easy to appreciate fully the labour entailed by his early work in this direction, and though he was most anxious for some younger man to complete his investigation of the yellow substances contained in this plant, no one has yet attempted to face the difficulties of this subject.

It is not possible in this short notice to attempt an account of the numerous researches of his long and active career; on the subject of madder, alizarine and various anthraquinone derivatives, he published more than thirty papers, and his contributions to the chemistry of the lichens, indigo, cochineal and chlorophyll have been of the highest importance. His early predilection for the study of natural products remained with him to the last, and until quite recently he was engaged upon the investigation of the colouring matter which is present in the common blackberry. The difficulty of the many subjects which he undertook and the elaborate care which he bestowed upon even the smallest operation account for the fact that he was less prolific than many of his contemporaries, but this, on the other hand, has added to the more permanent value of his researches. His dislike for slovenly or untidy work was characteristic of the man, and he frequently stated his inability to work in comfort should more than four glass vessels be upon the bench before him. Shortly after his father's death, which occurred in 1872, he erected his private laboratory at Kersal; this, which is probably the finest in the kingdom, he bequeathed to the Owens College, Manchester.

He was a Fellow of the Royal Society, for some years president of the Manchester Literary and Philosophical Society, a vice-president of the Chemical Society, and, from 1896–7, president of the Society of Chemical Industry, and in 1887, at the Manchester meeting, was president of the Chemical Section of the British Association. In 1898, he received the Dalton medal of the Manchester Literary and Philosophical Society; in 1899, the Davy medal of the Royal Society, and in 1900, the gold medal of the Society of Chemical Industry. He married, in 1851, Judith, the daughter of John Brooke, of Stockport, who survives him, and of his eight children four are now living.

A. G. P.

NOTES.

ALL who are interested in scientific progress will welcome the suggestion that the time has now fully arrived for obtaining a public portrait of Lord Rayleigh, whose work and influence have contributed greatly to the advancement of natural knowledge. The eminence of Lord Rayleigh as a scientific discoverer renders such a form of commemoration most desirable, and his public services in many capacities, including that of chairman of the board of the National Physical Laboratory, supply additional reasons. The proposition that steps should be taken to give effect to this project has already received the assent of a number of leaders in the scientific world, and Sir Andrew Noble, Sir Oliver Lodge and Prof. Arthur Schuster have consented to act as joint treasurers for this purpose. It is intended to circulate a first formal list of subscribers after the end of January. It is therefore desired that those who wish to participate will signify their intention to one of the treasurers, by name, at the address of the Royal Society. A meeting of subscribers will be called hereafter to decide upon the next steps to be taken.

THE successful inauguration of wireless telegraphic communication between the United States and England was accomplished by Mr. Marconi at the beginning of this week, which is less than a month after the first message was sent from Cape Breton, Canada, to this country. The distance from the United States station at Cape Cod to Cornwall is about 3000 miles, and is, therefore, greater than that from Cape Breton. The first message was sent from President Roosevelt to the King, and was dispatched by Mr. Marconi himself. The message read as follows:—"His Majesty King Edward VII., London. In taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting the system of wireless telegraphy, I extend on behalf of the American people the most cordial greetings and good wishes to you and all the people of the British Empire. (Signed) THEODORE ROOSEVELT." Later in the day, His Majesty replied in the following terms:—"To the President, White House, Washington. I thank you most sincerely for the kind message which I have just received from you through Signor

Marconi's Transatlantic wireless telegraphy. I sincerely reciprocate, in the name of the people of the British Empire, the cordial greetings and friendly sentiment expressed by you on behalf of the American nation, and I heartily wish you and your country every possible prosperity. (Signed) EDWARD R.' We heartily congratulate Mr. Marconi on this fresh success and hope that both the Transatlantic systems will soon be in continuous and useful operation.

AS an example of the way in which wireless telegraphy can contribute to the pleasantness, if not to the safety, of travelling by sea, we may call attention to the chess match which took place between two Atlantic liners whilst both were at sea. The *Lucania* started a match by wireless telegraphy with the *Minnetonka*, but after a few moves the communication was broken; later, however, the *Lucania* got into communication with the *Philadelphia*, and a second game was started, which was played out to a finish; the game lasted for three hours, and ended in a victory for the American team over the English. The ships were about fifty miles apart during the playing of the game.

ACCORDING to the *Daily Mail*, Mr. Marconi's system of wireless telegraphy is to be utilised to help forward the through telegraphic communication from the Cape to Cairo. A definite scheme, it is stated, is to be prepared at once, and in the meantime the African Transcontinental Telegraph Company will stop all further extensions from the south. At present, wires have been erected as far north as Lake Tanganyika, and it is expected that the final link between Cairo and Fashoda will be open very soon. Wireless telegraphy, it is hoped, will enable some of the difficulties of the country north of Lake Tanganyika to be surmounted successfully.

MR. QUINTIN HOGG, whose death we regret to record, was one of the few wealthy men in England who are sufficiently interested in educational work to devote their time and means to its advancement. He founded the Polytechnic Institution in Regent Street, London, in 1881, and is said to have spent about 100,000*l*. upon his scheme. The place was designed for 2000 members, but during the first winter the number reached 6800, and there are now between 17,000 and 18,000 members and students of both sexes. For quite twenty years (says the *Times*), Mr. Hogg devoted a large portion of his time, and much of his wealth, to this institution, the object of which was to provide evening teaching, technical training, gymnastics, music and rational amusement to the young men and girls of the commercial class in central London. The success of the Polytechnic was immense, and it provided the model on which all the others in London were formed in later years. No one can say how much the Polytechnic cost him in actual money, but it is believed that 6000*l*. a year is a moderate estimate, up to the date when the institution (with those newly founded on the same model) began to receive grants of public money. Mr. Henry Cunynghame points out in the *Times* that but for Mr. Hogg, London might still be without its polytechnics. It appears that an Act passed in 1883 enabled the Charity Commissioners to schedule the obsolete charities of the City of London and devote them to education. The Commissioners' attention was called to the Regent Street Polytechnic, "and ultimately on this model there arose that group of polytechnics which accommodate in London over 30,000 boys, and stand like forts in the sea of London temptations to youthful dissipation, ignorance and idleness."

THE article which Dr. A. R. Wallace contributes to *Black and White* of January 17, on his relations with Darwin in connection with the theory of natural selection, is a historical document of great scientific interest. Dr. Wallace was introduced to Darwin in the insect-room of the British Museum in 1854. While living in Borneo in 1854, Dr. Wallace wrote a paper "On the Law which has Regulated the Introduction of new Species," which was published in the *Annals of Natural History* in the following year. Hearing that Darwin was preparing some work on varieties and species, Dr. Wallace sent him a copy of his paper and received a long letter in reply, but no hint was given by Darwin of his having arrived at the theory of natural selection. Darwin had, however, actually written out a sketch of his theory in 1842, and in 1844 this sketch was enlarged to 230 folio pages, giving a complete presentation of the arguments afterwards set forth in the "Origin of Species." Dr. Wallace arrived at the idea of the survival of the fittest as the operating cause in evolution in 1858, and immediately sent the outlines of this theory to Darwin, who brought the communication before Sir C. Lyell and Sir Joseph Hooker, and urged that it should be printed at once. Upon their advice, however, he consented to let an extract from his sketch of 1844 be presented to the Linnean Society with Dr. Wallace's paper on July 1, 1858. "In conclusion," Dr. Wallace says, "I would only wish to add that my connection with Darwin and his great work has helped to secure for my own writings on the same questions a full recognition by the Press and the public; while my share in the origination and establishment of the theory of natural selection has usually been exaggerated. The one great result which I claim for my paper of 1858 is that it compelled Darwin to write and publish his 'Origin of Species' without further delay.' The story reflects great credit upon both Dr. Wallace and Darwin, and many naturalists will be glad to read it. We congratulate Dr. Wallace upon having presented the world with such an interesting record after attaining his eightieth birthday.

THE death is announced of Prof. Sirodot, correspondant of the section of botany of the Paris Academy of Sciences, and of Prof. Charles J. Bell, professor of chemistry in the University of Minnesota.

REUTER's agency reports that a sharp shock of earthquake of vertical direction and lasting two seconds was experienced at Davos on Monday afternoon.

PROF. J. H. LONG, of Northwestern University, has been elected president of the American Chemical Society, in succession to Prof. Ira Remsen.

THE report of the committee appointed by the Board of Agriculture to consider the question of forestry as regards Great Britain has been issued as a Blue-book.

A MANCHESTER telegram states that Dr. Schunck's bequest to Owens College, Manchester, does not include an endowment of 40,000*l*. as reported. It is confined to his valuable laboratory and laboratory buildings.

PROF. GUSTAV BISCHOF, formerly professor of technical chemistry at Anderson's College, Glasgow, died in London, on January 13, in his sixty-ninth year. He was known as an analytical chemist, principally in connection with water analysis.

MR. THOMAS SUTTON TIMMIS, of Allerton, near Liverpool, has vested in trustees a sum of 10,000*l*. to initiate systematic research into the origin and cure of cancer. The investigations will be conducted at the Liverpool Royal Infirmary and the new laboratories of experimental medicine in University College, Liverpool.

A CENTRAL NEWS telegram states that the tests of the new 16-inch gun, just mounted at Sandy Hook, took place on January 17 with complete success. Three shots were fired, one with the full service charge of 640 lb. of smokeless powder, said

to be the largest yet fired, and a projectile weighing 2400 lb. The shot struck the sea three miles from shore. The gun will have a range of twenty miles.

THE Paris correspondent of the *Times* states that at a meeting of the Academy of Moral and Political Sciences on January 17, the incorporation of the British Academy with the International Association of Academies was agreed to unanimously. Lord Reay, the first president of the British Academy, who is a correspondant of the Institute, expressed his thanks for the decision.

WE learn from *Science* that the Carnegie Institution of Washington has made a grant to the Marine Biological Laboratory, and now has at its disposal twenty tables in the laboratory at Woods Hole, Mass., for the season of 1903. These tables are intended for the use of persons engaged in original research in biology, and carry with them the right to be furnished with the ordinary supplies and material of the laboratory.

ACCORDING to the *Daily Mail*, Mr. Edward Baily, of Penzance, formerly of Mansfield, Notts, has presented to the Mansfield Town Council, in trust for his native town as a nucleus of a museum, a large and valuable collection of natural history specimens and scientific apparatus, collected by him during the past twenty years.

THE protection of the coasts from the inroads of the sea has become a matter of great importance in Norfolk and Suffolk. A meeting to consider what action should be taken was held at Norwich on Saturday last, many representatives of local bodies and public companies being present. Sir Samuel Hoare, M.P., wrote that he would like to see the Government appoint an experienced commissioner for Norfolk and Suffolk, or better still, one for each county, to report on the present encroachments, after some months' work and experiments, and to have under him officers in charge of certain portions of the coast who should keep records of daily, weekly and monthly observations. The following resolutions were adopted :—(1) "That the inroads of the sea upon the coasts of Norfolk and Suffolk have increased so much as to become a national danger ; that the existing powers of the local authorities and the financial resources at present available are insufficient for the construction and maintenance of adequate works of sea defence, and that the time has arrived when measures should be taken with the least possible delay to bring the subject, by petition or otherwise, to the notice of His Majesty's Government with the view of obtaining a Government inquiry, and some relief towards, or allowance in respect of, the cost of maintenance of such protection works." (2) "That a committee be formed, consisting of the members appointed by each of the local authorities concerned, with power to add to their number, together with their representatives in Parliament, to consider the best means for giving effect to the foregoing resolution, and, if considered advisable, to confer with other districts in the country similarly affected, and to report thereon to the respective local authorities, and that when necessary another conference be convened upon the subject."

A NEW system of telegraphic time-signals has been adopted by the U.S. Naval Observatory, Washington, and has many advantages over the method followed in this country. Instead of sending one signal at noon, as is done here for the noon signal from Greenwich, a series of signals, beginning at five minutes before noon and ending at noon, is sent out from the Observatory. This series agrees with that in use on the Pacific coast, so that the same system is now employed throughout the United States. During the interval over which the time-signals extend, every tick of the transmitting clock is signalled electrically, except the twenty-ninth second of each minute, the last five seconds of the first four minutes and the last ten seconds of the last minute. After this final break of ten seconds' duration, the noon signal is given. The electric connections of the transmitting clock at the Observatory emit certain sounds which can be easily distinguished by anyone listening to a sounder in a telegraph or telephone office. It is thus possible to recognise, by means of the breaks in the record, the middle and end of each minute, and especially the end of the minute which terminates at noon. As the signal is seldom in error to an amount greater than one- or two-tenths of a second, and electric transmission over a continuous wire is practically instantaneous, the series of noon signals provide a convenient means of accurately regulating clocks to standard time throughout the United States. The system is much to be preferred to that of sending a single signal at noon, as is done in this country for Greenwich time.

DURING the greater part of the week ended January 17, the British Isles were under the influence of an area of high barometric pressure, and experienced very cold *northerly* and *easterly* winds, the temperature being much below the average. The *Weekly Weather Report* just issued by the Meteorological Office states that the temperature was as much as 10° below the normal in the midland counties, 9° in Scotland W. and the western half of England, and between 8° and 6° in other parts of the kingdom. The highest of the maxima were recorded, as a general rule, towards the end of the period, and ranged from 50° in the Channel Islands and 49° in Ireland S. to 40° in Scotland E., England N.E. and the midland counties. At inland stations, the daily maxima during the week were frequently below 32°, and at Lairg on January 13 the highest reading was no more than 20°. The lowest of the minima were mostly recorded about the middle of the week. In Scotland N. (at Braemar on January 13), the screened thermometer registered a minimum of 1°, and on the following day, that at Lairg, Scotland N., fell to 6°. Elsewhere, however, the minima ranged from 12° in England N.W. and 13° in the midland counties to 20° in Ireland S. and 26° in the Channel Islands. In the neighbourhood of London, the greatest cold during the present winter, 24° in the screen, occurred on the night of Thursday to Friday, while at Greenwich the exposed thermometer on grass registered 12°. On Saturday a sudden thaw set in with snow and rain, which froze on touching the cold ground and formed a layer of ice known as silver thaw, owing to which very many accidents occurred to pedestrians.

IN his presidential address to the Institution of Engineers and Shipbuilders in Scotland, reported in the *Transactions*, Mr. William Foulis stated that several important changes had been made. The number of members of council was increased, the class of students was placed on a more satisfactory basis and a class of associate members was formed. The most important points for future improvement were, first, that a member of council should preside at students' meetings ; secondly, that a research committee should be formed ; and, thirdly, that more and better accommodation should be provided for the Institution and especially its library.

A MATHEMATICAL investigation of the theory of railway brakes is given by Prof. A. Sommerfeld in the *Denkschrift* of the Technical College at Aachen, published in connection with the Düsseldorf Exhibition. Prof. Sommerfeld divides the action of the brake into three phases, the first characterised by pure rolling of the wheels on the rails, the second by a mixture of rolling and slipping, while in the third phase the wheels slip along the rails without rolling. A consideration of the three phases leads to an explanation of the property that an increase of brake pressure sometimes reduces the efficacy of the brakes

instead of increasing it. In the investigation, account is taken of the dependency of the coefficient of friction on the velocity based upon experimental determinations.

SOME estimates of the stresses in the riveted attachments in ships are given in the December number of the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland by Dr. J. Bruhn. Taking ships of various dimensions, the author calculates the stresses at the gunwale amidships from the ordinary theory of bending, and the stresses in the rivets are obtained from the assumption that the stress is increased above that on the solid plate in proportion to the reduced sectional area. By drawing curves showing the relation between the stresses so calculated and the lengths of the ships, it is shown how the stresses on the edge riveting are being rapidly increased by the increase in the size of vessels and also by the tendency to let full-formed vessels proceed to sea in light or comparatively light conditions, particularly when water ballast has been added. Practically the only way of reducing the stresses is by increased rivet area. In some cases, this may be obtained by closing up the spacing of the rivets, but eventually, as the size of the ship increases, an additional row of rivets must be fitted.

AN interesting report on the plasticity of clays is presented to the *Bulletin de la Société d'Encouragement* for November 30, 1902, by M. B. Zschokke. Of the various theories of plasticity, the author attaches much importance to that of A. Rejtö, according to which the peculiar properties of clay are due in the main to the fact that the cohesion of its particles exceeds the internal friction. A number of experiments are described in which the tenacity of various samples of clay was tested by submitting cylinders to longitudinal traction. One remarkable result of these experiments is that the elongation previous to rupture is greater when the traction is applied rapidly than when it is applied slowly. With rapid tractions, the diagrams obtained show that the separated portions taper to sharp, almost cônical, points (Fig. 1), whereas with tractions applied gradually to the same samples of clay the breakage seems to take place abruptly before the constriction at the middle of the bar has become great (Fig. 2). This remarkable property is the exact opposite of that met with in the majority of substances, such as metals. The attempt to explain the phenomena has led M. Zschokke to a study of the microscopic structure of different samples of clay, in illustration of which several diagrams are given. Finally, the author defines plasticity as that property of a body, possessing as great a cohesion as possible, of undergoing, under the action of external forces, very great permanent deformations without the deformed body exhibiting any change in its cohesion relatively to the original body. Plasticity, it is pointed out, depends largely on the absorbing power of the clay and its attraction for the absorbed water, and the latter depends partly on the size of the particles and partly on the physical or chemical affinity between these particles and the water.

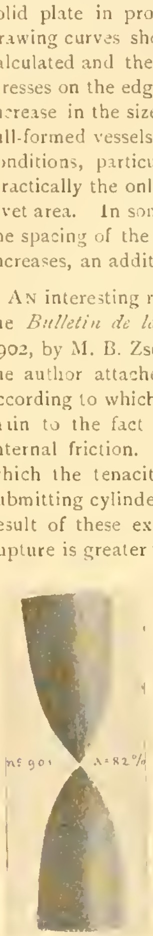


FIG. 1.

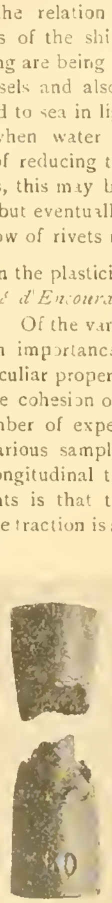


FIG. .

THE *Annales de l'Observatoire Astronomique* of Moscow (vol. iv., second series), which is published under the direction of Prof. W. Ceraski, contains some valuable contributions to astronomy. The volume opens with the reductions of the meridian observations made by M. Modestow of stars in the zone 0° to +4° declination, the object being to determine the positions of all stars down to magnitude 8. This is followed by three contributions by M. S. Blakjo on the calculation of occultation of stars by the moon, containing tables to facilitate reduction, observations of the Leonids in 1897, 1898 and 1899, and of the planet Mars in 1896–1897 (with plates). Prof. Ceraski gives a valuable photometric study of a certain number of stars in the constellation of Coma Berenices, and adds a process plate showing a portion of the region.

MR. H. A. BRYDEN contributes to the *Fortnightly Review* for January an article on the decline and fall of the South African elephant. It appears that the wild elephant has now practically ceased to exist south of the Cunene and Zambesi rivers. About the year 1830, elephant hunting in Cape Colony was prohibited by the British Government. Since that time, remaining herds have been carefully protected, and they still roam the dense jungles of the Knysna Forest and the Addo Bush in large numbers. It is a curious illustration of what a little timely preservation will do for wild creatures that often within a few miles of Port Elizabeth and Uitenhage there are strong troops of these animals, while one may travel elsewhere fifteen hundred miles up country and not succeed in finding a single wild elephant.

IN his recent report on the trade of Würtemberg for the year 1901 and part of 1902, Dr. F. Rose, H.M. Consul at Stuttgart, refers to the heavy fall in the price of carbolic acid owing to the manufacture of this substance by a synthetic process. The commencement of the manufacture of synthetic carbolic acid in Germany was, the report points out, the direct result of the prohibition of the export of carbolic acid from the United Kingdom in January, 1900. In a former report, Dr. Rose, in the course of some remarks on the production of synthetic carbolic acid, said that "the high prices for phenol, caused by the prohibition and the low price of benzol in Germany, were instrumental in giving a great impetus to the endeavours of German chemists to discover a cheap working method of preparing phenol synthetically from benzol, and thus rendering Germany independent of the export from the United Kingdom. The danger to the British export trade of carbolic acid then foreshadowed has now become an actual fact."

IN a reprint of a pamphlet from the *Humane Review* entitled "The Fate of the Fur-Seal," the author, Mr. J. Collinson, directs attention to the cruelties connected with the driving and slaughter of these animals on the Pribiloffs, as well as to the evils of pelagic sealing.

A RECENT fasciculus (No. 1310) of the *Proceedings* of the U.S. National Museum is devoted to materials for a monograph of the North American insects of the order Thysanoptera. At the conclusion of the memoir, the author, Mr. W. E. Hinds, discusses the phylogeny of the different sections of the group.

WE have received a copy of a second lecture on "Thoroughbreds and their Grassland," by the Rev. E. A. Woodruffe-Peacock, forming No. 2 of the *Rural Studies Series*, in which the nature of soils and the best kinds of grass with which to sow them are discussed.

THE *American Naturalist* for December contains an important paper, by Prof. A. W. Grabau, on the morphology and growth of the gastropod shell, with especial reference to the protoconch, or embryo-shell. Attention is called to the fact that several of the modern limpet-like shells, such as Acmæa and Crepidula, have coiled protoconchs, whence it is inferred that this type of shell is probably not, as might at first sight

have been supposed, primitive. The subject is largely treated from the palæontological aspect.

CAPTAIN BARRETT-HAMILTON has sent us a copy of his paper, from the November number of the *Zoologist*, on the origin of sexual dimorphism and nuptial weapons and ornament. It is stated that the recent investigations into the life-history of the salmon, published by the Scotch Fishery Board, confirm the author's view as to the setting free of proteids and other compounds in the breeding salmon, and their transference to various parts of the body.

As is well known, the typhoid bacillus produces little or no toxin in artificial cultivations, and all attempts to obtain a typhoid antitoxin have hitherto proved failures. Chantemesse, however, by growing the typhoid bacillus in a special culture medium prepared from spleen and bone marrow, claims to have obtained a toxin with which he has been able to immunise horses and to prepare a typhoid antitoxin. Of 179 cases treated with the latter, seven died, a case-mortality of only 3·7 per cent., whereas of 1192 cases treated during the same period on general principles, 286 died, a case mortality of 19·3 per cent. (*La Presse Médicale*, December 24, 1902, p. 1227).

THE function of the flagellated body of the malaria parasite was for a long time a disputed question. In 1898, MacCallum found that in the Halteridium, a malaria-like parasite of birds, there were two varieties of the parasite, a granular and a non-granular, and he observed that it was only the latter that developed flagella. He had the good fortune to observe a flagellum from a non-granular parasite enter and fuse with a granular one, and therefore concluded that the flagellum was a fertilising element. It was suggested that the same would hold good for the malaria parasite, and MacCallum stated that he had actually observed this to be the case. Dr. Moore, of the University of Texas, announces that he has been fortunate enough to observe the phenomenon in a case of æstivo-autumnal fever. A hyaline or non-granular body was seen to be in active movement, and in a moment four active flagella were extruded. One of these became separated and happened to come in contact with a granular body, and after several attempts entered into this and became fused with it (*Johns Hopkins Hosp. Bull.*, October, 1902, p. 235).

FOLLOWING closely upon the revised list of herbaceous plants which was issued last June, a welcome addition to the literature originating from the Royal Botanic Gardens, Kew, is furnished by a new edition of the "Hand List of Trees and Shrubs Grown in the Arboretum." This does not include the Coniferæ, which are undergoing revision. Previously produced in two parts, the present list includes in the single volume the monocotyledons and all the dicotyledons to the number of about four thousand five hundred.

THE second fasciculus of the supplement to the "Index Kewensis" has been presented by M. T. Durand and Mr. B. Daydon Jackson, having been published, like the first, at Brussels. Included are genera from Cymbidium to Iriha, either new genera or those to which new species or synonyms were added during the decade commencing with the year 1886. Cypripedium and Dendrobium are considerably enlarged, chiefly owing to the enumeration of new hybrids; the additions to Hieracium are principally European, which is accounted for by the fact that during the era many investigators, notably Hanbury in Britain, were working out the variations of this polymorphic genus throughout the continent.

THE development of a somewhat rare Gasteromycete is described by Mr. J. R. Johnston under the name of *Cauloglossum transversarium*. A central columella runs throughout, the gleba contains chambers which are lined with basidia, and the periderm is very thin and ruptures irregularly, exposing the glebal folds. Cauloglossum may be regarded as a synonym for Podaxon, hence the author proposes the name Rhopalogaster and favours affinity with the Hysterangiaceæ. The paper appears in the *Proceedings* of the American Academy of Arts and Sciences, from which source comes also a fifth list of new species of Laboulbeniaceæ, with diagnoses contributed by Prof. Roland Thaxter. These are forms which were found growing on the bodies or appendages of insects.

ONE of the last reports issued by the Weather Bureau in Manila describes "the seismic and volcanic centres of the Philippine Archipelago." The author of this report, M. Saddera Masó, S.J., divides the Archipelago into four districts or sections, and for each of these gives, in chronological order with short descriptions, lists of large earthquakes and volcanic eruptions. In looking over these records, the earliest of which refers to the year 1599, it is interesting to note the instances in which these two phenomena have agreed in time. The relative frequency of earthquakes in the Archipelago is shown by a coloured map, by tables and by curves. Since 1880, maxima occurred in 1881 and 1897, with a minimum in 1886. The distribution of earthquakes in the rainy season (June to October), the dry cold season (November to February) and the dry hot season (March to May) are in the ratios 100 : 73 : 53. Other tables and diagrams refer to distribution of shocks according to years, months and hours, but it cannot be said that they show any marked periodicities.

MESSRS. A. E. STALEY AND CO. (35 Aldermanbury, E.C.) have sent us a small pamphlet entitled "Mahomet and the Mountain, a Modern Miracle," which they have just published The text is devoted to the elucidation of many points connected with the use of the telephotographic lens, and should be found serviceable to those who are commencing the use of this form of lens. Several typical illustrations are inserted. Those who wish to read this booklet can obtain one from the publishers post free on application.

THE twentieth volume of the *Geographical Journal*, containing the monthly issues from July to December, 1902, is now available. It commences with the address delivered by the president, Sir Clements Markham, F.R.S., to the Royal Geographical Society at the anniversary meeting. In addition to numerous other articles of interest, the volume contains a summary of the results of his latest journey in Central Asia by Dr. Sven Hedin; contributions by Mr. Ellsworth Huntington, on a journey through the great cañon of the Euphrates River; by Mr. Oscar Neumann, on an expedition from the Somali coast through southern Ethiopia; and by Dr M. A. Stein, on a journey of geographical and archæological exploration in Chinese Turkestan. Interesting particulars are also to be found concerning the departure of the *Morning* in search of the *Discovery* in connection with the National Antarctic expedition. The liberal supply of illustrations, charts and maps make with the papers an instructive and interesting record of geographical work.

THE additions to the Zoological Society's Gardens during the past week include a Binturong (*Arctictis binturong*) from the Malay Peninsula, presented by Mr. M. A Hawes; an Indian Crow (*Corvus splendens*) from India, presented by Mr. D. Asbury; an American Golden Plover (*Charadrius americanus*), captured at sea, presented by Mr. G. Carrick; a Blackbird, var. (*Turdus merula*), a Long Thrush (*Turdus musicus*) British, presented by Miss Alice Ellis; a Coquerel's Mouse Lemur (*Chirogaleus coquereli*) from Madagascar, six Himalayan Monauls (*Lophophorus impeyanus*) from the Himalayas, two Brush Turkeys (*Talegalla lathami*) from Australia, three South Island Robins (*Mira albifrons*) from New Zealand, deposited.

OUR ASTRONOMICAL COLUMN.

NEW COMET 1903*a* (GIACOBINI).—A telegram from the Kiel Centralstelle states that M. Giacobini, observing at Nice, has discovered another new comet, the position of which at 6h. 28m. ·9 (Nice M.T.) on January 19 was as follows :—

$$\text{R.A.} = 22\text{h. } 57\text{m. } 48\text{s.}$$
$$\text{Dec.} = +2^\circ\ 16'\ 24''$$

that is, between the stars β and 2 Piscium, about one-third the distance from β.

The daily movements in R.A. and Dec. are + 17′ (arc) and − 12′ respectively.

COMET 1902 *d*.—No. 3838 of the *Astronomische Nachrichten* contains several sets of observations of this comet, and the elements and ephemeris given below. The latter have been calculated by Herr F. Ristenpart from the means of three observations made on December 3, three observations made on December 11 and of two observations made on December 23, all of them having been made by different observers :—

T = 1903 March 25·32785 M.T. Berlin.

$$\left.\begin{array}{l}\omega = \ \ 6^\circ\ 33'\ 43''\cdot1 \\ \Omega = 117\ \ 26\ \ 47\cdot3 \\ i = \ 43\ \ 51\ \ \ 2\cdot1\end{array}\right\}1903\cdot0$$
$$\log q = 0\cdot440250$$

Ephemeris 12h. M.T. Berlin.

Date	α 1903·0 h. m. s.	δ 1903·0 ° ′ ″	log Δ
Jan. 22	6 47 20·87	+10 37 21·8	
24	6 46 3·56	+11 17 30·7	0·2791
26	6 44 49·64	+11 57 47·6	
28	6 43 39·45	+12 38 7·3	0·2816
30	6 42 33·42	+13 18 24·3	
Feb. 1	6 41 31·88	+13 58 33·9	0·2852

THE RELATION BETWEEN FACULÆ AND PROMINENCES.—In No. 11, vol. xxxi., of the *Memorie della Societa degli Spettroscopisti Italiani*, Signor Mascari submits a large number of arguments and data in order to show that there is no real connection between the solar hydrogen prominences and faculæ, but that where faculæ are attended by other outbursts, these outbursts are of the eruptive prominence type.

For instance, in 1895, the prominences had a maximum frequency at +30° to +40° and −20° to −30° (heliographic latitudes), and strong minima at ±60° to ±90° respectively, whilst the groups of faculæ showed an almost symmetrical arrangement with regard to the solar equator, having only slight maxima of frequency at +10° to +20° and ±70° to ±80° ; the same relations held during 1896, and many similar cases are quoted by the writer for other years.

Again, out of two hundred and ninety-six groups of faculæ observed in 1900, only fourteen were coincident with ordinary prominences, whilst ninety-nine coincided with eruptive prominences having bases of small extent.

Signor Mascari therefore arrives at the conclusion that the hydrogen prominences, such as are commonly observed on the sun's limb, and faculæ are two distinct and completely independent phenomena.

SPECTROGRAPHIC DETERMINATION OF THE ROTATION PERIOD OF JUPITER.—Two excellent spectrograms of Jupiter, obtained by Mr. V. M. Slipher, of the Lowell Observatory, Flagstaff, Mexico, are reproduced in No. 101 of *Popular Astronomy*. No. 1 was taken in such a position that the dispersion was parallel to the equatorial diameter of the planet, whilst in No. 2 the dispersion was parallel to the polar diameter.

No. 1 shows a very distinct displacement or inclination of the lines in the planet's spectrum as compared with the lines in the lunar spectrum, which was photographed as a comparison spectrum on both sides of it. In No. 2, this displacement was non-existent. Measurements of the displacement in spectrogram No. 1 were made, and, on applying Doppler's principle to them, values for the rotation period which are well in accordance with the accepted values were obtained.

THE PHOTOGRAPHY OF STELLAR REGIONS.—In a paper recently communicated to the Vienna Academy of Sciences, Herr Egon von Oppolzer discusses the question as to how the greatest number of star images may be obtained when photographing stellar regions.

He points out that in an objective uncorrected for curvature of the focal surface, this surface is a sphere having its centre in the centre of the objective, and it will only be on the intersection curve (a circle) of this sphere and the photographic plate that the star images will be in focus, and therefore it will only be on this curve that images of the fainter stars will be obtained. The further from the curve the star image happens to fall, the greater will have to be the magnitude of the star in order that its image may be photographed.

Herr Oppolzer then establishes a relation connecting the distance of a star image from this focal circle, the radius of the focal circle and the focal length of the objective, and finally arrives at the conclusion that the formula $\delta_0 = L2/16f$ (where L = the length of the side of the square plate and f = the focal length of the objective) gives the best distance (δ_0) that the plate must be pushed in from the axial focus in order that the maximum number of stars may be photographed. Applying this formula to the Potsdam astrographic refractor, we find that the plate should have been pushed in 0·47 mm., whereas we see, from the Potsdam plates for the "Carte Celeste," that it was only pushed in 0·13 mm., and Herr Oppolzer deduces from this that an unnecessary loss, amounting to as much as 6 per cent., has occurred in the number of stars photographed (*Astrophysical Journal*, No. 5, vol. xvi.).

THE FORMATION OF PEARLS.[1]

BY far the greater number of recent writers on pearls, whether scientific or otherwise, when discussing the cause of pearl-formation, have contented themselves with recapitulating what has already been written on the subject, without attempting to verify or refute the various hypotheses that have been propounded. The question is one which has called forth speculative theories since the earliest times of which we have any records ; but, with the exception of the brilliant researches of Filippi and a few of his contemporaries, theory has prevailed to the almost complete exclusion of practical investigation.

In a recent paper,[1] based upon an examination of large quantities of material comprising a number of the pearl-producing species of mollusca, I have tried to place our knowledge of the matter upon a more satisfactory basis.

By observations upon pearl-bearing examples of the common mussel, *Mytilus edulis* (which were confirmed in the case of all other species examined), I proved that the formation of the pearl takes place in exactly the same way as that of the shell, except that a true pearl is laid down in a closed sac of the shell-secreting epithelium, embedded in the subepidermal tissue of the mantle and completely cut off from the outer epithelium itself. Inside this spherical epithelial sac, the shell substance is laid down in the concentric layers that are so characteristic of the pearls, instead of in the parallel lamellæ which are found in the shell itself. Such a sac, with its contained pearl, may be compared to a human atheroma cyst.

This makes it necessary for us to draw a sharp distinction between pearls proper and blisters or pearly excrescences of the shell lining, which are secreted by the outer (shell-forming) mantle epithelium, to cover over foreign bodies that have intruded themselves between the mantle and the shell or to repair the damages done by shell-boring domiciliaries. "Concretions" are, again, distinguished from pearls as calcosphæritic bodies which have not a cuticular origin from an epithelium, but seem to arise by free crystallisation in the mantle or other tissues. The term "attached pearl" should be applied only to pearls which have become secondarily fused to the shell by absorption of the intervening tissues.

From the facts of pearl-formation, it is easy to understand why the pearl presents the special characters of the particular species of shell from which it is taken, and also why, in the same mollusc, the characters of the pearls produced are determined by the part of the mantle in which they are formed. Thus, pearls formed in the extreme mantle margin are composed mainly of periostracum, *e.g.* the leathery pearls of *Modiola modiolus*, while those which occur in the part of the mantle concerned in depositing the prismatic substance are made up of

[1] "On the Origin of Pearls." By Dr. H. Lyster Jameson (*Proceedings* of the Zoological Society of London, 1902, vol. i., pp. 140–166, pl. xiv–xvii.).

concentric layers of rod-like prisms, as in the brown or "black" pearls of the Scotch river mussel, *Margaritana margaritifera* (Fig. 1).

By far the greater part of the mantle epithelium deposits the nacre, and pearls which arise in this part of the mantle are the typical nacreous ones, to which the great majority of the marketable gems belong. Even the uncalcified substance of the hinge ligament of the shell may be represented in the pearl; for example, in the great Australian mother-of-pearl oyster, *Margaritifera maxima*, Jameson, black leathery pearls are sometimes found in the dorsal body-wall.

I next proceeded to investigate the origin of the sac in which the pearl arises, and also the nature and origin of the "nucleus" which is so often to be found in the centre of the pearl. In a great many molluscs, among which were several of the pearl-oysters proper, the remains of trematodes were found to form the nuclei, a discovery which confirmed the observations of Filippi, Möbius and others. In one or two cases, however, other parasites played the same part. By confining my attention to the common mussel, I proved that the epithelial sac, which is all-important for pearl formation, is first formed around the live trematode which enters upon a resting stage in the tissues of Mytilus. A similar sac, surrounding a trematode, was found in an example of the Ceylon pearl-oyster, *Margaritifera vulgaris*, Schumacher, which I examined. For the formation of the pearl, it is not necessary for the trematode to persist as nucleus, for it often happens that it migrates out of the sac; but the sac, caused primarily by the

FIG. 1.—Section ground from a brown Scotch River Pearl, showing it to be composed of the Prismatic Substance, × 25.

specific stimulation of the parasite, is essential to pearl production. In *Modiola modiolus*, and probably in some other forms, similar sacs are formed around Sporozoa.

The next subject to be investigated was the origin and life-history of the parasite that causes the pearl-sac. The common mussel was found to be the most convenient species on which to study this, and the pearl-bearing mussel-beds of Billiers, in Brittany, and Piel, in the Barrow Channel, were selected as suitable sites in which to begin the observations (Fig. 2).

The parasite, like most trematodes, passes through a regular cycle of three hosts, two of which are invertebrates and the third a vertebrate. It arises in sporocysts in the "tapestry shell," *Tapes decussatus*, and the cockle, *Cardium edule*, the former acting as first host at Billiers, the latter at Piel, where Tapes does not occur. The young tailless Cercariæ or trematode larvæ leave the mother sporocysts in the first host and migrate into the mussel.

The transmission of the parasites from Tapes to Mytilus was proved experimentally in a tank at the Brighton Aquarium. In the mussel, the parasite enters into a resting stage, in the sub-epidermal connective tissue, and gives rise to the epidermal sac or "epithelioma" in which the pearl arises (Fig. 3). If the parasite dies in this sac, a pearl is formed around its remains, or, if it migrates to another part of the tissues, a pearl may be developed in the empty sac.

Although it was found impossible to secure live uninfected material of the final host for experiment, it is almost certain that the adult stage of the parasite is *Distoma* (*Leucithodendrium*) *somateriae*, Lev., a worm which occurs in the intestine of the eider duck, *Somateria mollissima*, and the black duck or scoter, *Oedemia nigra*. Both these birds feed almost exclusively on mussels. A number of scoters caught or shot in the immediate vicinity of the Billiers pearl-beds were found swarming with

FIG. 2.—The Pearl-bearing Mussel-beds at Piel, in the Barrow Channel.

this worm. Indeed, one example of the worm, in an immature condition, quite indistinguishable from the resting stage which occurs in Mytilus, was taken from the intestine of a scoter. Our knowledge of the life-histories of other trematodes, or "flukes" as they are popularly called, enables us to fill in the life-history of this parasite with considerable detail. The worm reaches maturity in the intestine of the scoter and eider, and the eggs pass out with the fæces. These eggs, or possibly "Miracidium" larvæ derived from them, enter Tapes or the cockle and there give rise to sporocysts, in which the young flukes

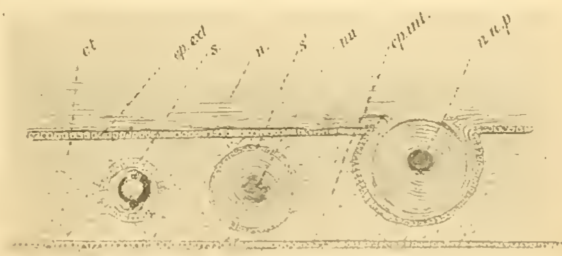


FIG. 3.—Diagrammatic section of part of the shell and mantle of Mytilus, showing a trematode in its sac, a pearl in a similar sac and a secondarily attached pearl; *n.*, nacreous substance of the shell; *ep. ext.*, external nacre-secreting epithelium of the mantle; *c.t.*, connective tissue; *s.*, sac containing live trematode; *s'*, sac containing pearl; *nu.*, nucleus of pearl; note also the sac of an "attached" pearl, which has become continuous with the external epithelium of the mantle; *n.a.p.*, nucleus of the attached pearl; *ep. int.*, internal ciliated epithelium of mantle, which lines the branchial cavity.

or Cercariæ are formed. These larvæ, unlike typical Cercariæ, are tailless, and when they escape from Tapes reach the mussel chiefly by drifting with the tidal currents. On entering the mussel, they pierce the body wall and settle down in the sub-cutaneous tissues, in which they become surrounded by the pearl-sacs. If the mussel lives long enough, pearls will be formed in these sacs. If, on the other hand, a mussel containing these resting Cercariæ is eaten by an eider duck or scoter, the Cercariæ develop into the mature worms, which produce eggs, and the life cycle is repeated.

As an economic result of these investigations, it would seem

that the artificial production of marketable pearls in large quantities should present no great difficulties, if the conditions essential to pearl production in the particular cases be intelligently investigated. The fact that trematodes have been ascertained to be *at least* one cause of pearl formation in several of the molluscs that produce the marketable gems gives us every reason to hope that, by learning the life-histories of these parasites, we may be able to infect any number of pearl-oysters or pearl-mussels to any desired extent, without any operation on the individual molluscs, by simply placing them in the proper surroundings, in company with infected examples of the first host. Once infected, the molluscs could be bedded out on suitable grounds, and left to care for themselves, until the pearls formed in them were of marketable size.

These observations show the futility of the proposal that has so often been made, viz., that young pearl-oysters should be transferred from their native grounds to more accessible inshore waters, as it must obviously be the first object of the scientific expert, before laying down the beds of young pearl-oysters, to assure himself either that they are already infected or that the conditions essential to speedy infection are present on the grounds to which the oysters are to be transplanted.

H. LYSTER JAMESON.

THE MOVEMENTS OF GLACIERS.

THE study of the movements of glaciers is, we are glad to say, being steadily pursued, judging from the two reports which are to hand. The first is a publication of the International Commission on Glaciers, and is the seventh report (1901) prepared by Dr. Finsterwalder and M. E. Muret (extract from *Archives des Sciences physiques et naturelles*, t. xiv., 1902). The report is divided into five parts, dealing with observations made in the Alps of Central Europe, Scandinavia, Spitsbergen and Greenland, Russia and, lastly, the United States. In each case, a brief summary is given of the results of the 1891 observations published during the past year, and most of these show that, on the whole, the glaciers have decreased in length.

The second publication contains, not only a report on the variations of French glaciers from 1900 to 1901, presented to the French Commission by M. W. Kilian, but a review of glaciology, by M. Charles Rabot (extract from the *Annuaire du Club Alpin Français*, vol. xxviii., 1901). Detailed observations are given at some length, and in a few instances reproductions of photographs of glaciers accompany the text. The observations indicate that during this period of time the majority of the glaciers have recoiled or diminished in length. In the second portion of this publication, M. Rabot passes in review the most recent and important works on glaciology, and thus collects a useful number of references to works on this subject. After a brief survey of the physical and geological phenomena, he makes a *résumé* of the explorations of glaciers in different parts of the earth, pointing out the more interesting facts connected with them, and finally gives an account, with numerous references, of the variations of the length of glaciers in different regions.

THE SCIENCE OF ASTRONOMY.[1]

I TAKE for the subject of my address the science of astronomy, and propose to give a brief historical sketch of it, to consider its future development and to speak of the influence of the sciences on civilisation.

The science of astronomy is so closely connected with the affairs of life, and is brought into use so continuously and in such a systematic manner, that most people never think of the long labour that has been necessary to bring this science to its present condition. In the early times, it was useful to the legislator and the priest for keeping records, the times of public ceremonies and of religious festivals. It slowly grew into the form of a science and became able to make predictions with some certainty. This was many centuries ago. Hipparchus, who lived 150 B.C., knew the periods of the six ancient planets with considerable accuracy. His periods are:—

[1] Address delivered by Prof. Asaph Hall, on December 29, 1902, as president of the American Association for the Advancement of Science, Washington meeting.

	Period. d.	Error × 100. Period. d.
Mercury	87·9698	+0·0007
Venus	224·7028	+0·0009
Earth	365·2599	+0·0010
Mars	686·9785	−0·0002
Jupiter	4332·3192	−0·0061
Saturn	10758·3222	−0·0083

These results indicate that more than two thousand years ago there existed recorded observations of astronomy. Hipparchus appears to have been one of those clear-headed men who deduce results from observations with good judgment. There was a time when those ancient Greek astronomers had conceived the heliocentric motions of the planets, but this true theory was set aside by the ingenious Ptolemy, who assumed the earth as the centre of motion, and explained the apparent motions of the planets by epicycles so well that his theory became the one adopted in the schools of Europe during fourteen centuries. The Ptolemaic theory flattered the egotism of men by making the earth the centre of motion, and it corresponded well with old legends and myths, so that it became inwoven with the literature, art and religion of those times. Dante's construction of Hell, Purgatory and Paradise is derived from the Ptolemaic theory of the universe. His ponderous arrangement of ten divisions of Paradise, with ten Purgatories and ten Hells, is said by some critics to furnish convenient places for Dante to put away his friends and his enemies, but it is all derived from the prevailing astronomy. Similar notions will be found in Milton, but modified by the ideas of Copernicus, which Milton had learned in Italy. The Copernican theory won its way slowly, but surely, because it is the system of nature, and all discoveries in theory and practical astronomy helped to show its truth. Kepler's discoveries in astronomy, Galileo's discovery of the laws of motion and Newton's discovery of the law of gravitation put the Copernican theory on a solid foundation. Yet it was many years before the new theories were fully accepted. Dr. Johnson thought persecution a good thing, since it weeds out false men and false theories. The Copernican and Newtonian theories have stood the test of observation and criticism, and they now form the adopted system of astronomy.

The laws of motion, together with the law of gravitation, enable the astronomer to form the equations of motion for the bodies of our solar system; it remains to solve these equations, to correct the orbits, and to form tables of the sun, moon and the planets. This work was begun more than a century ago, and it has been repeated for the principal planets several times, so that now we have good tables of these bodies. In the case of the principal planets, the labour of determining their orbits was facilitated by the approximate orbits handed down to us by the ancient astronomers, and also by the peculiar conditions of these orbits. For the most part, the orbits are nearly circular; the planets move nearly in the same plane, and their motions are in the same direction. These are the conditions Laplace used as the foundation of the nebular hypothesis. With approximate values of the periods and motions, and under the other favouring conditions, it was not difficult to form tables of the planets. However, the general problem of determining an orbit from three observations, which furnish the necessary and sufficient data, was not solved until about a century ago. The orbits of comets were first calculated with some precision. Attention was called to these bodies by their threatening aspects and by the terror they inspired among people. It was, therefore, a happy duty of the astronomers to show that the comets also move in orbits around the sun and are subject to the same laws as the planets. This work was easier, because the comets move nearly in parabolas, which are the simplest of the conic sections. Still, the general problem of finding the six elements of an orbit from the six data given by three observations remained to be solved. The solution was given by Gauss a century ago in a very elegant manner. His book is a model, and one of the best ever written on theoretical astronomy. No better experience can be had for a student than to come in contact with such a book and with such an author. The solution of Laplace for the orbit of a comet is general, but demands more labour of computing than the method of Olbers, as arranged by Gauss. It is said by some writers that the method of Laplace is to be preferred because more than three observations can be used. In fact, this is necessary in order to get good values o.

the derivatives of the longitudes and latitudes with respect to the time, but it leads to long and rather uncertain computations. Moreover, it employs more data than are necessary, and thus is a departure from the mathematical theory of the problem. This method is ingenious, and by means of the derivatives it gives an interesting rule for judging of the distance of a comet from the earth by the curvature of its apparent path, but a trial shows that the method of Olbers is much shorter. Good preliminary orbits can now be computed for comets and planets without much labour. This, however, is only a beginning of the work of determining their actual motions. The planets act on each other and on the comets, and it is necessary to compute the result of these forces. Here again the conditions of our solar system furnish peculiar advantages. The great mass of the sun exerts such a superior force that the attractions of the planets are relatively small, so that the first orbits, computed by neglecting this interaction, are nearly correct. But the interactions of planets become important with the lapse of time, and the labour of computing these perturbations is very great. This work has been done repeatedly, and we now have good numerical values of the theories of the principal planets, from which tables can be made. Practically, therefore, this question appears to be well toward a final solution. But the whole story has not been told.

The planets, on account of their relative distances being great and because their figures are nearly spherical, can be considered as material particles, and then the equations of motion are readily formed. In the case of n material particles acting on each other by the Newtonian law, and free from external action, we shall have $3n$ differential equations of motion, and $6n$ integrations are necessary for the complete solution. Of these only ten can be made, so that in the case of only three bodies there remain eight integrations that cannot be found. The early investigators soon obtained this result, and it is clearly stated by Lagrange and Laplace. The astronomer, therefore, is forced to have recourse to approximate methods. He begins with the problem of two bodies, the sun and a planet, and neglects the actions of the other planets. In this problem of two bodies, the motions take place in a plane, and the integrations can all be made. Two constants are needed to fix the position of the plane of motion, and the four other constants pertaining to the equations in this plane are easily found. This solution is the starting point for finding the orbits of all the planets and comets. The mass of the sun is so overpowering that the solution of the problem of two bodies gives a good idea of the real orbits. Then the theory of the variation of the elements is introduced, an idea completely worked out into a practical form by Lagrange. The elements of the orbits are supposed to be continually changed by the attractions of the other planets. By means of this theory, and the mathematical machinery given by Lagrange, which can be applied to a great variety of questions, the observations of the planets can be satisfied over long intervals of time. When this theory of the motions was carried out a century ago, it appeared that the great problem of planetary motion was near a complete solution. But this solution depends on the use of series, which undergo integrations that may introduce small divisors. An examination of these series by Hansen, Poincaré and others indicates that some of them are not convergent. Hence the conclusions formerly drawn about the stability of our solar system are not trustworthy and must be held in abeyance. But looking at the construction of our system, and considering the manner in which it was probably evolved, it appears to be stable. However, the mathematical proof is wanting. In finding the general integrals of the motions of n bodies, the assumption that the bodies are particles gets rid of the motions of rotation. These motions are peculiar to each body and are left for special consideration. In the case of the earth, this motion is very important, since the reckoning of time, one of our fundamental conceptions, depends on this motion. Among the ten general integrals that can be found, six belong to the progressive motion of the system of bodies. They show that the centre of gravity of the system moves in a right line and with uniform velocity. Accurate observations of the stars now extend over a century and a half, and we are beginning to see this result by the motion of our sun through space. So far, the motion appears to be rectilinear and uniform, or the action of the stars is without influence. This is a matter that will be developed in the future. Three of the other general integrals belong to the theory of areas, and Laplace has drawn from them his theory of the invariable plane of the system. The remaining integral gives the equation of living force. The question of relative motion remains, and is the problem of theoretical astronomy. This has given rise to many beautiful mathematical investigations and developments into series. But the modern researches have shown that we are not sure of our theoretical results obtained in this way, and we are thrown back on empirical methods. Perhaps the theories may be improved. It is to be hoped that the treatment of the differential equations may be made more general and complete. Efforts have been made in this direction by Newcomb and others, and especially by Gyldèn, but so far without much practical result.

The problem of three bodies was encountered by the mathematicians who followed Newton, and many efforts were made to solve it. These efforts continue, although the complete investigations of Lagrange appear to put the matter at rest. The only solutions found are of very special character. Laplace used one of these solutions to ridicule the doctrine of final causes. It was the custom to teach that the moon was made to give us light at night. Laplace showed by one of the special solutions that the actual conditions might be improved and that we might have a full moon all the time. But his argument failed, since such a system is unstable and cannot exist in nature. But some of the efforts to obtain partial solutions have been more fruitful, and G. W. Hill has obtained elegant and useful results. These methods depend on assumed conditions that do not exist in nature, but are approximately true. The problem of two bodies is a case of this kind, and the partial solutions may illustrate, but will not overcome, the fundamental difficulty.

The arrangement of our solar system is such that the distances of the planets from one another are very great with respect to their dimensions, and this facilitates very much the determination of their motions. Should two bodies approach very near each other, the disturbing force might become great, even in the case of small masses. In the case of comets, this condition happens in nature, and the comet may become a satellite of a planet and the sun a disturbing body. In this way, it is probable that comets and meteoric streams have been introduced into our solar system. We have here an interesting set of problems. This question is sometimes treated as one of statics, but since the bodies are in motion it belongs to dynamics. Further study may throw light on some relations between the asteroids and the periodical comets.

The great question of astronomy is the complete and rigorous test of the Newtonian law of gravitation. This law has represented observations so well during a century and a half that it is a general belief that the law will prove true for all time and that it will be found to govern the motions of the stars as well as those of our solar system. The proof is cumulative and strong for this generality. It will be a wonderful result if this law is found rigorously true for all time and throughout the universe. Time is sure to bring severe tests to all theories. We know that the law of gravitation is modified in the motions of the matter that forms the tails of comets. There is an anomaly in the theory of Mercury which the law does not explain, and the motion of our moon is not yet represented by theory. The lunar theory is very complicated and difficult, but it does not seem probable that the defect in Hansen's theory will be found by recomputing the periodical coefficients, that have been already computed by many mathematicians and astronomers, and with good agreement by Hansen and Delaunay, by very different methods. Hansen was a computer of great skill, but he may have forced an agreement with observations, from 1750 to 1850, by using a coefficient of long period with an erroneous value. No doubt the error of this theory will be discovered. Back of all theories, however, remains the difficulty of solving the equations of motion so that the result can be applied with certainty over long periods of time. Until this is done, we shall not be able to subject our law to a crucial test.

The constants that enter the theories of the planets and moon must be found from observations. In order to compare observations made at distant epochs, the motions of the planes of reference must be known with accuracy, and also the motion of our solar system in space. As the stars are our points of reference, their positions and their proper motions must be studied with great care. This department of astronomy was brought to a high degree of order by the genius of Bessel, whose work forms an epoch in modern astronomy. The recent progress made in determining the positions of the stars in all parts of the heavens will be a great help to the investigations of the future.

We must have observatories where accurate and continuous observations are made. Our country is well situated to supplement the work of Europe, and we hope it will never fail to add its contribution to the annals of astronomy. American astronomers should keep pace in the improvements for increasing the ease and accuracy of making observations. The spectroscope has given a new element in the motions of the stars, not to speak of the interesting physical results obtained by its use. Photography will give great aid in determining the relative positions of the stars and in forming maps of the heavens. All new methods, however, will need examination and criticism, since they bring new sources of error. Fifty years ago, it was thought the chronograph would increase very much the accuracy of right ascensions. It has not done this directly to any great extent, but it has increased the ease and rapidity of observing. We must remember that astronomical results finally depend on meridian observations, and that it is the duty of astronomers to make these continuous from generation to generation. In this way, we shall gain the powerful influence of time to help control and solve our problems. There is one point where a reform may be needed from the dead weight of the large and expanding volumes sent forth by observatories and scientific institutions. The desire for publication is great, but the results should be well discussed and arranged, so that the printing may be shortened. Otherwise our publications may become burdensome, and when they are piled up in libraries some future Caliph Omar may be tempted to burn them. Even mathematics appears to labour under a similar oppression, and much of its printed matter may be destined to moulder to useless dust.

In the not distant future, stellar astronomy will become a great and interesting field of research. The data for the motions of the stars are becoming better known, but these motions are slow, and the astronomer of to-day looks with envy on the astronomer of a thousand years hence, when time will have developed these motions. Much may be done by the steady and careful work of observation and discussion, and the accumulation of accurate data. Here each one of us can add his mite. But the great steps of progress in science have come from the efforts of individuals. Schools and universities help forward knowledge by giving to many students opportunities to learn the present conditions, and from them some genius like Lagrange or Gauss may come forth to solve hard questions and to break the paths for future progress. This is about all the schools can do. We need a body of men who can give their lives to quiet and continuous study. When the young Laplace was helped to a position where he could devote his life to research, D'Alembert did more for the progress of astronomy than all the universities of Europe.

One needs only to glance at history to see how useful astronomy has been in the life of the world. It has wonderfully enlarged the universe and widened the views of men. It shows how law and order pervade the world in which we live; and by the knowledge it has disseminated and by its predictions it has banished many superstitions and fears. The sciences will continue to grow, and they will exert the same influence. The erroneous and dogmatic assertions of men will be pushed aside. In our new country, the energies of the people are devoted chiefly to commercial and political ends, but wealth is accumulating, leisure and opportunity will come, and we may look forward to a great development of scientific activity. We must be patient. Men do not change much from generation to generation. Nations that have spent centuries in robbery and pillage retain their dispositions and make it necessary for other nations to stand armed. No one knows when a specious plea for extending the area of civilisation may be put forth, or when some fanatic may see the hand of God beckoning him to seize a country. The progress of science and invention will render it more difficult for such people to execute their designs. A century hence it may be impossible for brutal power, however rich and great, to destroy a resolute people. It is in this direction that we may look for international harmony and peace, simply because science will make war too dangerous and too costly.

The influence of the sciences in bringing men of different nationalities into harmony is great. This is done largely by the common languages that are formed in each science. In mathematics, the language is so well formed and generally adopted that mathematicians all over the world have no trouble in understanding one another. It may be difficult to read Russian, but everyone can read the formulas of Tchebitchef and Lobaschewsky. In astronomy, the common language is nearly as well established, so that there is little difficulty in understanding the astronomy of different nations. A similar process is going on in chemistry, botany and in the other sciences. When men are striving for the discovery of truth in its various manifestations, they learn that it is by correcting the mistakes of preceding investigators that progress is made, and they have charity for criticism. Hence persecution for difference of opinion becomes an absurdity. The labours of scientific men are forming a great body of doctrine that can be appealed to with confidence in all countries. Such labours bring people together, and tend to break down national barriers and restrictions. The scientific creed is constantly growing and expanding, and we have no fears, but rejoice at its growth. We need no consistory of bishops, or synod of ministers, to tell us what to believe. Everything is open to investigation and criticism.

In our country we have one of the greatest theatres for national life that the world has ever seen. Stretching three thousand miles from ocean to ocean, and covering the rich valleys of the great rivers, we have a land of immense resources. Here is a vast field for scientific work of various kinds. No doubt the men of the future will be competent to solve the problems that will arise. Let us hope that our national character will be just and humane, and that we may depart from the old custom of robbing and devouring weak peoples. Anyone who saw the confusion and waste in this city in 1862 might well have despaired of the Republic; and he who saw the armies of Grant and Sherman pass through the city in 1865 felt that he need fear no foreign foe: neither French emperor, nor English nobleman nor the sneers of Carlyle. To destroy a democracy by external force, the blows must be quick and hard, because its power of recuperation is great. The danger will come from internal forces produced by false political and social theories, since we offer such a great field for the action of charlatans. Our schools and colleges send forth every year many educated people, and it is sometimes disheartening to see how little influence these people have in public life. Those who are trained in the humanities and churches ought to be humane in dealing with other people, ready to meet great emergencies and powerful to control bad tendencies in national affairs. But this is rarely the case. On the other hand, the most unscrupulous apologists and persecutors have been educated men, and the heroes of humanity have come from the common people. This anomaly points to something wrong in the system of education, which should disappear. The increase and teaching of scientific ideas will be the best means of establishing simple and natural rules of life. Nature, and science her interpreter, teach us to be honest and true, and they lead us to the Golden Rule.

THE ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS.

ON Saturday last, the Association of Public School Science Masters held its annual meeting at the University of London. Sir A. W. Rücker, the president, took the chair, and in the morning the proceedings were of a business character. Rules were revised, officers and committee elected and reports read. It was decided that, in order to preserve the original intentions of the society, its members should consist of teachers of natural science in secondary schools and of not more than twenty others interested in such teaching. It transpired that the present membership is ninety-six and that the only large public school still unrepresented is St. Paul's.

The report of the subcommittee appointed to consider the question of entrance scholarships at Oxford and Cambridge was presented, and Mr. H. B. Baker announced that the suggestions to be offered to the universities, by invitation at a very early date, had been submitted to every member of the Association, with the result that an objection had been raised by but one member.

Prof. Tilden was elected president for the year 1904, Mr. C. E. Ashford was re-appointed secretary, while in order to lessen his work a new office of treasurer was created and filled by the election of Mr. J. Talbot, one of Mr. Ashford's colleagues, who will be able to render him useful assistance. It was arranged that the members of committee should retire by rotation and are not eligible to re-election until three years afterwards, this step being taken in order that the smaller schools might be represented upon the committee.

It will be remembered that the Association grew out of a

conference, and in the afternoon a similar one—the third of its kind—was opened. Three papers were read, the first of which, on the tyranny of Greek, was by Mr. J. Talbot, of Harrow. He said that the amount of Greek which boys did at school was too small to be of any use, and he suggested that its place should be taken by English and by science, though from the latter alone he considered that it was impossible to obtain literary style. Sir Michael Foster pleaded for elasticity of curriculum and no compulsory Greek, though he did not define what he would substitute for it. Prof. Armstrong argued that if science was studied, literary style could be acquired at the same time. In the end, the meeting agreed that compulsory Greek should not be required of candidates for entrance examinations at the universities.

Mr. E. C. Sherwood, of Westminster, in his address dealt with how to make practical work of any use in "a low big form." He was of opinion that lectures should be used to sum up and criticise the work of the previous lesson. Text-books in the laboratory he considered a snare and a delusion, and he maintained that notes should be roughly written at the time and copied out carefully in ink afterwards. In the discussion, however, a number of speakers characterised it as a mistake for any notes to be made away from the laboratory. Furthermore, Mr. Sherwood laid down that the aim of the very earliest course of chemistry and physics, especially if not preceded by a course of "nature-study," should be to train the powers of observation and description, as well as to give a familiarity with the nature and properties of the commoner substances and materials, and the object and application of the easier methods of manipulation. The "problem" and the heuristic element should not be prominent features.

The third paper consisted of a criticism, by Dr. T. J. Baker, of Birmingham, on the new syllabus for science in the matriculation examination of the University of London. In this contribution, it was pointed out that it is now possible to matriculate at London without offering any science at all. It was contended that a matriculation examination should test the grounding of candidates in this as well as in literary subjects. At the same time, there should be no incentive to specialisation as in the new science syllabus under consideration.

This contention was borne out by the fact that chemistry has been separated from physics and the latter divided into two sections each of which counts as a distinct subject. The standard of attainment required is too high and directly encourages specialisation. Dr. Baker would retain only chemistry and mechanics, the syllabus in the first case being limited in scope, but insisting upon thoroughness of treatment.

Sir A. W. Rücker, in the course of a well-considered speech, explained that the syllabus complied with Sir Michael Foster's desire for elasticity. He alluded to the difficulty of examining 2500 candidates practically at a fixed centre, and showed how the University had arranged to test the pupils of a school on the spot by means of the leaving examination recently devised.

WILFRED MARK WEBB.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR MICHAEL FOSTER has decided to retain his seat in Parliament as member for the University of London. In a letter to Sir John Rotton, he says:—"The answers which you have received to the inquiry which you kindly made on my behalf give me so fully the assurance which I needed in order that I should feel justified in renouncing my intention to resign that I have decided to do so."

SIR WILLIAM TURNER, K.C.B., F.R.S., who has held the chair of anatomy in the University of Edinburgh since 1867, has been elected principal of the University.

THE *Lancet* states that the Bristol Health Committee has decided that the bacteriological work which has been done hitherto in the medical officer's department shall be for one year transferred to the University College, where it will be carried on by Prof. Stanley Kent at a cost of 200*l*.

A LABORATORY has been opened in the gardens of the Royal Botanic Society at Regent's Park, in which classes for instruction in botany and horticultural chemistry are held three days a week. Mr. E. J. Schwartz, demonstrator in botany at King's College, has been appointed director, and has now completed arrangements for the reception of pupils. The laboratory has been erected and equipped under the auspices of the Technical Education Board.

THE Carnegie Institution of Washington has adopted, *Science* says, a plan to encourage exceptional talent by appointing a certain number of research assistants. As a rule, the annual emolument will not exceed 200*l*., and no limitations are prescribed as to age, sex, nationality, graduation or residence. A person appointed will generally be expected to work under the supervision of a man of science known to the authorities of the Carnegie Institution. Applications for appointments may be presented by the head of a college, or by a professor, or by the candidate; they should be accompanied by a statement of the qualification of the candidate, of the research work he has done and of that which he desires to follow; also of the time for which an allowance is required.

IN a speech made at the opening of the Indian Industrial Exhibition in connection with the eighteenth Indian National Congress, the Gaekwar of Baroda referred to the question of education in India. The *Pioneer Mail* says that his Highness founded an institution called the Kala-Bhavan with departments in dyeing and weaving, carpentry and mechanical engineering, and with the object of diffusing technical education had branches of it set up in the various parts of the Raj; but the response among the people was so faint that after a time the institution had to be contracted within narrower limits. Until the means of the people and the material wealth of the country expand, there can be but little demand for the work which such institutes turn out. So far, the Kala-Bhavan has done but little beyond providing skilled dyers for Bombay mills.

SCIENTIFIC SERIAL.

Journal of Botany, January.—Mr. E. S. Salmon traces out the characters and history of several mosses which, after a careful examination, he considers should be included under the species *Calyptopogon mnioides*, Schwaeg. The type specimen was collected in Chili, but others were obtained in Ecuador, Patagonia, New Zealand, Tasmania and Australia. This distribution is paralleled in the case of several other mosses, and a similar range was described for certain phanerogamous plants by Sir W. J. Hooker. The identity of these variously named forms receives confirmation by the presence of gemmæ which arise on the leaves.—Mr. E. G. Baker discusses Turræa, a genus belonging to the Meliaceæ, and in the main follows the classification laid down by Dr. Harms in the "Pflanzenfamilien." The African and Mascarene species are arranged separately, and in the former appear descriptions of two new species.—Two Hepatics new to Britain are recorded. *Kantia submersa* was gathered by Messrs. A. Wilson and J. A. Wheldon on Cockerham Moss, west Lancashire, and *Geocalyx graveolens* was discovered by Mr. S. M. Macvicar, in west Ross-shire.—Miss A. L. Smith, in the course of her description of a gooseberry disease caused by a form of Botrytis, mentions the appearance of a Peziza growing from a sclerotium, which also gave rise to *Sclerotinia Fuckeliana*.—A note on the localities of *Acorus Calamus* is contributed by Mr. Arthur Bennett.—A supplement to the *Journal* is devoted to notes on the drawings for "English Botany," by Mr. F. N. A. Garry. This work, generally known as Sowerby's "English Botany," bears tribute to the artist who drew the plates; the descriptions of the first edition were almost entirely written by Sir James E. Smith.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 11, 1902.—"On Certain Properties of the Alloys of the Gold-Silver Series." By the late Sir William **Roberts-Austen**, K.C.B., F.R.S., and Dr. T. Kirke **Rose**.

The earliest trial plate for testing the composition of the gold coinage was made in 1527, the year following the first introduction of the standard 916·6. This plate contained only 6·2 parts per 1000 of copper and was probably intended to consist of gold and silver only. All subsequent plates, however, down to that made in 1829, contained much larger amounts of copper.

In 1873, it was determined to omit the silver and to use only copper as the alloying metal, but Sir W. C. Roberts-Austen expressed some doubts at the time whether plates consisting of alloys of gold and copper were uniform in composition, and proposed the use of trial plates of pure gold. There are, how-

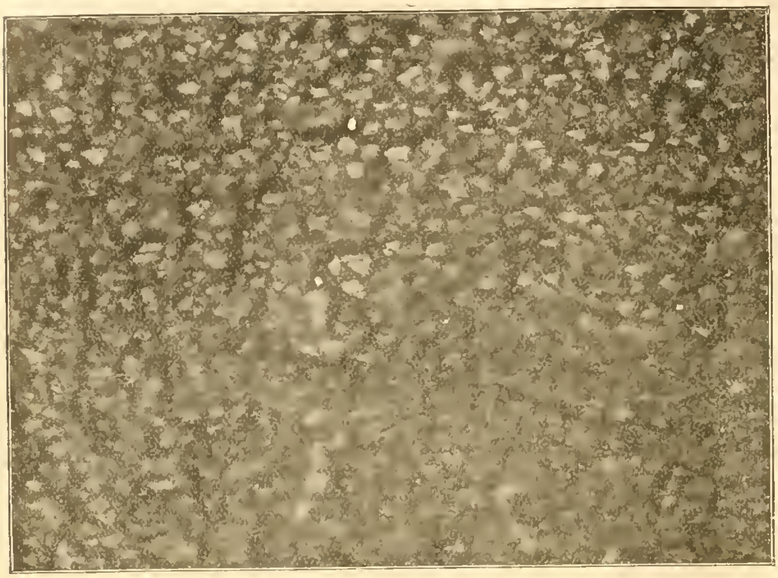


Fig. 1.—Alloy consisting of gold 91·6 per cent., silver 8·3 per cent. Cast. × 1500.

ever, objections to this method of procedure, and the law enjoining the use of standard plates was not altered.

In 1900, the authors of this paper showed that, as had been feared, the gold copper alloys were not homogeneous (*Roy. Soc. Proc.*, vol. lxvii., 1900, p. 105), and experiments on the gold-silver series were then made. Cooling curves of the alloys

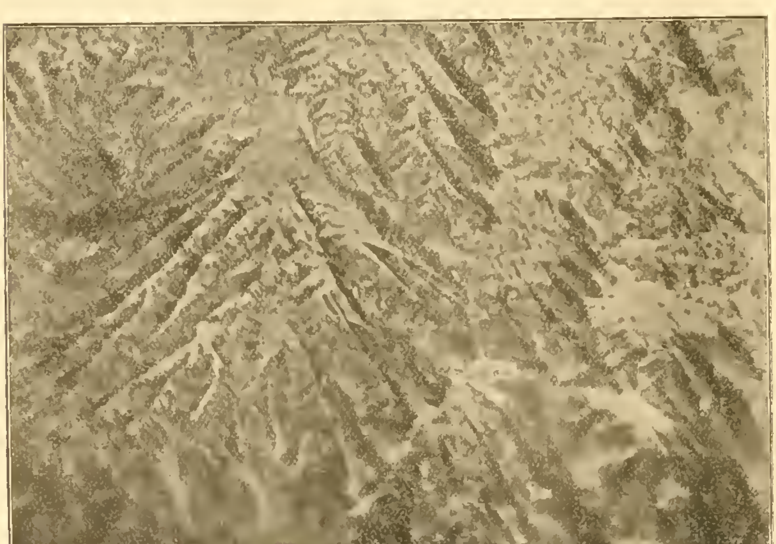


Fig. 2.—Same as Fig. 1. Annealed for two months. × 1500.

were taken by the Roberts-Austen recording pyrometer, with the result that all the alloys were found to solidify without passing through a pasty stage and no traces of a eutectic alloy were observed. The first additions of silver to gold do not lower its point of solidification, and the freezing-point curve was shown to be horizontal in passing from pure gold to the alloy containing 50 atoms of silver to 50 of gold. With further additions of silver, there is a steadily increasing fall in the freezing point until the lowest point is reached at pure silver. There is accordingly no reason to suppose that, when alloys rich in gold are allowed to cool from a molten state, the first portion of metal solidified would be different in composition from the mother liquor.

The alloys all consist of large grains built up of minute secondary crystals, shown in Fig. 1, in which the alloy containing 916·6 parts of gold and 83·3 of silver is shown under a magnification of 1500 diameters. An ingot of this composition was heated for two months in an annealing furnace at a low red heat, but although the size of the crystals was greatly increased, as shown in Fig. 2, in which the magnification is the same as in Fig. 1, no true segregation could be detected in the ingot either by assay or with the aid of the microscope. Plates prepared by rolling out ingots of standard fineness were found on analysis to be uniform in composition, and they have been used throughout the year 1902 for checks in the assay of standard bars and coin. In view of the minute accuracy with which the operations of coinage have to be conducted, this is a matter of much practical importance.

Royal Astronomical Society, January 9.—Dr. J. W. L. Glaisher, F.R.S., president, in the chair.—Prof. H. H. **Turner** read a preliminary note by Mr. **Bellamy** and himself on the possible existence of two independent stellar systems. The investigation described in a previous paper had been extended to the southern hemisphere and the number of stars in each square degree had been counted; the differences of distribution were apparently best explained by assuming the existence of a belt of stars. This seemed to point to the existence of two superposed stellar systems. It was proposed to make a further study of the solar motion in space, first from stars in the suggested belt and then from stars in the Milky Way.—Mr. A. R. **Hinks** read a paper on a graphical method of applying to photographic measures the terms of the second order in the differential refraction. It appeared that Prof. Turner's method of reducing measures in linear coordinates had the advantage that the small differences (refraction, &c.) are linear functions of the coordinates, but the method loses its simplicity when corrections involve terms of the second order. A graphical method was suggested for finding separately and applying to the measures such parts of the reductions as are of the second order. The author had succeeded in constructing diagrams by means of which these small terms can be quickly found for any plate.—The secretary partly read a paper by Mr. J. E. **Gore** on the sun's stellar magnitude, obtained from a consideration of binary stars the orbits of which were well determined and the spectra of which were of the solar type.—The secretary also gave an account of a paper which had been communicated by the **Astronomer Royal** on statistics of stars in a zone of 5°, from + 65° to + 70° declination, counted on photographs taken for the Astrographic Chart and Catalogue at the Royal Observatory, Greenwich. The paper gave a comparison of the number of stars for each square degree on the photographs with those of the Bonn Durchmusterung, and an analysis of the number of stars in each square degree in terms of duration of

exposure.—The **Astronomer Royal** read a paper describing his proposals for the reproduction and publication, on a scale twice that of the original plates, of the photographs for the Astrographic Chart made at the Royal Observatory, Greenwich.—The **Astronomer Royal** also read a note on photographs of Giacobini's comet. taken at the Royal Observatory.—Mr. H. C. **Plummer** briefly described the object of his paper on the use of Mr. Aldis's tables of the function $\frac{1}{2}(\theta + \cos\theta)$ in determining the elements of an orbit.—Other papers were taken as read.—A photograph of a Leonid meteor taken by Mr. W. W. Payne at Carleton College Observatory, Northfield, Minnesota, was exhibited on the screen.

Geological Society, January 7.—Prof. C. Lapworth, F.R.S., president, in the chair.—On the discovery of an ossiferous cavern of Pliocene age at Dove Holes, Buxton (Derbyshire), by Prof. W. Boyd **Dawkins,** F.R.S. The Carboniferous Limestone, in the neighbourhood of Dove Holes, has from time to time yielded remains of extinct Mammalia of Pleistocene age. The latest discovery is of a group of Mammalia of far higher antiquity than the Pleistocene. The Victory Quarry, Bibbington, in which the discovery was made, is excavated in a rolling plateau of Carboniferous Limestone. In the course of working the quarry, a cave was discovered. It ran nearly horizontally north and south, and consisted of a large chamber and a small passage, both eroded in a master-joint. It was filled with a horizontally stratified red clay, containing angular and rolled pebbles of limestone, and a few sandstone-pebbles from the Millstone Grit and Yoredale rocks. Scattered through the mass were mammalian bones and teeth, some waterworn and others with sharp fractures. The contents had clearly been introduced into the cave by water, flowing under geographical conditions which no longer exist. The mammalian remains belong to the following species:—*Machairodus crenatidens*, Fabr.; *Hyaena*, sp.; *Mastodon arvernensis*, Croiz. and Job.; *Elephas meridionalis*, Nesli.; *Rhinoceros etruscus*, Falc.; *Equus stenonis*, Nesli.; *Cervus etueriarum*, Croiz and Job. All these species are found in the Upper Pliocene deposits of France and Italy, and undoubtedly belong to that age. Some of the bones present the characteristic teeth-marks of the hyænas. The author concludes that the animal-remains have been washed out of a hyæna-den, which then existed at a higher level, and carried down deep into the rock, into the cave in which they were found, along with the clay and pebbles brought down in flood-time from the Yoredale and Millstone-Grit hills. The author appends a map illustrating the physical geography of the British Isles in Upper Pliocene time. There were then no physical barriers to forbid the migration of Machairodus, Mastodon, *Elephas meridionalis*, and the rest, from central and southern France into Britain. Over this area, the animals migrated in the Upper Pliocene age. The discovery of a few of them in Derbyshire is to be looked upon as a monument of their former existence over the whole of this region.

EDINBURGH.

Mathematical Society, January 9.—On the decimalisation of English money and some simplifications in long division, by J. D. Hamilton **Dickson** and the late J. Hamblin **Smith.**—Note on the preceding paper, by J. W. **Butters.**—Notes on anti-reciprocal points, by A. G. **Burgess.**—On the singular points of plane curves, by Dr. **Sprague.**

PARIS.

Academy of Sciences, January 12.—M. Albert Gaudry in the chair.—On some new halogen derivatives of dextrorotatory benzylidenecamphor and benzylcamphor, by MM. A. **Haller** and J. **Minguin.** By the addition of hydrobromic acid to benzylidenecamphor, a compound is obtained which can be clearly distinguished from the benzylbromocamphors by the different products obtained on opening up the camphor ring.—On the glycolysis of the blood *in vitro*, by MM. R. **Lépine** and **Boulud.**—The president announced to the Academy the loss by death of M. Sirodot, correspondent in the section of botany.—The variations in the activity of reduction of oxyhæmoglobin in the course of a balloon ascent, by M. **Tripet.** Observations were made at altitudes up to 5000 metres on three subjects, with the following results. At great altitudes, the duration of reduction of the oxyhæmoglobin diminishes to less than one-half of the normal time of reduction, this diminution in the balloon in the absence of all fatigue being nearly instantaneous. In all three subjects, the proportion of oxyhæmoglobin increased with the height. As the balloon approached the earth, the converse phenomena were noted, but the return to the normal was slow and was not completed on arriving at the surface of the earth. The results of observations on the arterial blood-pressure at varying heights are also given.—On a reciprocal transformation in mechanics, by M. Paul J. **Suchar.**—On the existence in certain differential systems of integrals responding to given initial conditions, by M. Ch. **Riquier.**—On the singular trajectories of the problem of three bodies, by M. T. **Levi-Civita.**—On graphical statics in space, by M. B. **Mayor.**—Resistivity and temperature, by M. **Ponsot.**—On two silicides of manganese, by M. P. **Lebeau.** The existence of a manganese silicide, MnSi, in steel has been indicated by MM. Carnot and Goutal, and of a silicide, $SiMn_2$, by M. Vigouroux, but neither of these has been isolated in a state of purity. It has been shown in a previous paper that copper silicide can be utilised in the preparation of the silicon compounds of iron and cobalt, and the same reaction applies equally wel to the study of the silicides of manganese.—On the expansion of tempered steels, by MM. Georges **Charpy** and Louis **Grenet.** The results of M. Svedelins on the contraction and variation in the coefficient of expansion of annealed and tempered steels are to a certain extent confirmed, but the differences found in the coefficients of expansion are not so great.—On the chloride of cinnamylidene, by MM. Ernest **Charon** and Edgar **Dugoujon.** This is produced by the interaction of cinnamic aldehyde and phosphorus pentachloride under certain conditions which are described. The compound is very unstable and is readily acted upon by water or moist air. The addition products with chlorine and bromine are described.—The action of sodium on iodophenoxypropane, by M. l'Abbe J. **Hamonet.**—On the use of nitrates for the characterisation of sweet wines, by M. **Curtel.** Advantage is taken of the presence of nitrates in sugar from the beet to detect the addition of sugar to wine.—On some cephalopods collected during recent voyages of the Prince of Monaco, by M. L. **Joubin.**—On two new types of parasitic Epicaridæ, by M. Jules **Bonnier.**—The fossil fishes of Belgium, by M. Maurice **Leriche.**—Preliminary note on the geology of the Isle of Eubée, by M. **Deprat.**—On glacial observations made in Upper Maurienne in the summer of 1902, by M. Paul **Girardin.** The phenomenon of pyrenolysis in the cells of the hepato-pancreatic gland of *Europagurus Bernardus*, by M. L. **Launoy.**—Organic sexual dimorphism in the Gallinaceæ and its variation with feeding, by M. Frédéric **Houssay.**—On the presence of saccharose in almonds and on its function in the formation of oil, by M. C. **Vallée.**—On the formation of the purple of *Purpura lapillus*, by M. Raphaël **Dubois.** The author holds, contrary to the views expressed by M. Letellier, that the mechanism of formation of the colouring matter in Purpura is the same as in the genus Murex, and is the result of the activity of a zymase, to which the name of purpurase is given.—Researches on the influence of variations of altitude on the respiratory exchanges, by M. J. **Tissot.** A table of the experimental results obtained by two observers in a captive balloon is given, the discussion of the results being reserved for a future note.—A comparative study of the activity of production of glycose by striated muscle, by MM. **Cadéac** and **Maignon.**—On the calculation of the amount of water added and cream removed in milk analyses, by MM. **Louise** and Ch. **Riquier.** A criticism of a formula of M. Génin. It is necessary to take into account the change of volume produced by the removal of cream.—Remark on the origin of volcanic activity, by M. Stanislas **Meunier.** Remarking on the views recently put forward by M. Gautier, the author points out that they are identical with those put forward by him some time ago.

NEW SOUTH WALES.

Linnean Society, November 26, 1902.—Mr. J. H. Maiden, president, in the chair.—Studies on Australian Mollusca, part vii., by Mr. C. **Hedley.** An examination of the history of nomenclature shows that the current names of many well-known marine forms are defective. *Purpura amygdala* is shown to apply properly to a West Australian species; the Sydney shell usually so called is described as *P. pseudamygdala* *Venus australis*, Sowerby, is replaced by *Chione lagopus*, Lamarck, and *Capulus danieli* of Angas (not Crosse) by *C. australis*, Lamarck. A new species of Cæcum, lately discovered by Miss Parker, is added to the fauna under the name of *C. lilianum.*

Some hitherto unfigured Victorian land shells are also illustrated. Finally, the species of Triforis dwelling on the coast of New South Wales are reviewed, the total being raised from four to fourteen, including nine new species.—Notes on Prosobranchiata, No. ii., Littorinacea, by Mr. H. Leighton **Kesteven.** While studying the affinities of Fossarina and Risellopsis, the writer found that Risella differed in important anatomical characters from Littorina, the type genus of the family to which, in the past, it had been assigned. As a result of studying Risella, Littorina and Tectarius and comparing their anatomy with that of other Tænioglossa, he has found it advisable to reclassify the littorine groups thereof.—Notes on Australian Rhopalocera: Lycænidæ, part ii., by Mr. G. A. **Waterhouse.** One species of Pseudonotis and two of Philiris are described as new.—Ngarrabul and other Australian tribes, part i., medical and surgical practice, by Mr. John **MacPherson.** Before the advent of the white settler, the Blacks affirm that there was but little sickness or disease of any kind. Tumours or neoplasms were unknown. The work of the doctors was mainly surgical, and consisted of the treatment of wounds or injuries—the result of accident or sustained in warfare. Sorcery and witchcraft, however, occupied a prominent place in the practice of medicine. Knocking out the incisor teeth, circumcision and subincision were not in vogue among the Ngarrabul Blacks, and no instances of perforation of the septum nasi were met with. Particulars relating to the materia medica are recorded.—On the occurrence of Monograptus in New South Wales, by Mr. T. S. **Hall.** The occurrence of Graptolites in the Silurian rocks of Bowning and Yass has already been recorded by Mr. John Mitchell in the Society's *Proceedings* (1886, p. 577; 1880, 150). A careful study of the specimens on which these records were based shows that they are undoubted examples of Monograptus. The imperfection of the specimens in the sicular region prevents absolute identification, but, so far as can be made out, they apparently belong to the group typified by *M. dubius*, which ranges through almost the whole of the Lower Ludlow and Wenlock in Britain.—On a new species of Symplocos from New South Wales, by Mr. R. T. **Baker.** This new Symplocos is a small, glabrous shrub of about 6 to 9 feet high, and differs considerably in general facies from the three species *S. spicata*, Roxb., *S. Stawelli*, F.v.M., *S. paucistaminea*, F.v.M., already described from Australia.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 22.

ROYAL SOCIETY, at 4.30.—Preliminary Note on the Relationships between Sun-spots and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—Characteristics of Electric Earth-Current Disturbances, and their Origin: J. E. Taylor.—Solar Eclipse of 1900, May 28. General Discussion of Spectroscopic Results: J. Evershed.—Some Dielectric Properties of Solid Glycerine: Prof. E. Wilson.—On the Electrodynamic and Thermal Relations of Energy of Magnetisation: Dr. J. Larmor, Sec. R.S.

SOCIETY OF ARTS, at 4.30.—Indian Domestic Life: J. D. Rees.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on the Metric System. Opened by Mr. Alexander Siemens, in favour of the Metric System, and by Sir Frederick Bramwell, Bart., in favour of the British System.

FRIDAY, JANUARY 23.

ROYAL INSTITUTION, at 9.—Recent Volcanic Eruptions: Dr. Tempest Anderson.

PHYSICAL SOCIETY, at 5.—On the Oscillating Table for determining Moments of Inertia: W. H. Derriman.—Note on an Elementary Treatment of Conducting Network: Prof. L. R. Wilberforce.—On the Theory of the Quadrant Electrometer: G. W. Walker.

SATURDAY, JANUARY 24.

MATHEMATICAL ASSOCIATION, at 2.—On some Class Diagrams for Intuitional Geometry: E. M. Langley.—On the Representation of Imaginary Points on a Plane by Real Points: Prof. A. Lodge.—Incommensurables by Means of Continuous Decimals: Edwin Budden.

MONDAY, JANUARY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Irrigation and Colonisation in British East Africa: R. B. Buckley.

INSTITUTE OF ACTUARIES, at 5.—Temporary Assurances: W. P. Elderton.

TUESDAY, JANUARY 27.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Nile Reservoir, Assuan: M. Fitzmaurice, C.M.G.—Sluices and Lock-Gates of the Nile Reservoir, Assuan: F. W. S. Stokes.

ANTHROPOLOGICAL INSTITUTE, at 8.—Presidential Address. The Position of Anthropology and its Needs: Dr. A. C. Haddon, F.R.S.

WEDNESDAY, JANUARY 28.

SOCIETY OF ARTS, at 8.—The Cost of Municipal Trading: Dixon H Davies.

THURSDAY, JANUARY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers:*—Relation between Solar Prominences and Terrestrial Magnetism: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—On the Bending of Electric Waves round a Conducting Obstacle: H. M. Macdonald, F.R.S.—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Temperature: Miss S. C. M Sowton and J. S. Macdonald.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans.

FRIDAY, JANUARY 30.

ROYAL INSTITUTION, at 9.—Vibration Problems in Engineering Science: Prof. W. E. Dalby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of the Electrical Equipment of a Light Railway: J. R. MacIntosh.

CONTENTS.

THURSDAY, JANUARY 29, 1903.

SCIENCE AND THE NAVY.

THE Board of Admiralty are to be entirely congratulated upon their new scheme of entry, education and training of officers, which has recently been printed *in extenso* in the *Times*, and already given rise to much comment on the part both of naval officers and schoolmasters.

The most important parts of it, from our point of view, are that it shows that, in the opinion of the Admiralty, for the naval service the education obtained by studying things instead of books is essential, and that the scheme set forth is sound and broad in its educational details. The mere existence of it for the purpose intended is certain in time, we believe, to have a profound effect, not only upon the entrance examinations to the Army and the Civil Service, but upon secondary and university education generally. We may go further and say that if the Council of Defence were anything more than a name, the naval scheme would have formed part of a more general one embracing the whole armed service of the country.

Let us see what improvements are proposed upon the present system. First of all, a battleship is to be made more of a fighting unit than it is at present by having all the officers, whether navigating, gunnery, torpedo, engineer, and those more numerous lieutenants whose duties are not specially devoted to any particular branch, but excepting medical officers and the accountant branch, educated alike up to a certain point. The Army is a non-scientific body with scientific corps; the Navy is to be a scientific body all round.

At present, the marine officers enter late after the often soul-destroying training of the ordinary schools which provide the officers of the Army. The engineer officers enter earlier at a special naval engineering establishment. The executive officers enter the *Britannia* at the age of $14\frac{1}{2}$ to $15\frac{1}{2}$ for four terms, and we believe the instruction given in the first three is something like this:—

Mathematics, including Navigation and Chart Work	$30\frac{1}{2}$ hours a fortnight.
French	6 ,, ,,
Steam	4 ,, ,,
Mechanical Drawing	$3\frac{1}{2}$,, ,,
Instruments	3 ,, ,,
Physics	1 ,, ,,
Naval History	$1\frac{1}{2}$,, ,,
Seamanship	$6\frac{1}{2}$,, ,,

In the fourth term, the cadets are sent for a cruise, and are further instructed in practical navigation, instruments and chart work, steam and seamanship.

It will readily be gathered, then, that on the present system, in the schools which furnish the cadets, not much attention need be paid to physical science and the mental training that it brings, if *one hour a fortnight* is all that is provided for it on the *Britannia*.

Under the new scheme, all the officers to whom reference has been made will enter the *Britannia* between the ages of twelve and thirteen, thus saving some two years of ordinary school training. As the age is so low, nomination and a limited competitive examination are preferred to an open examination. This, we consider, is justified, but some alterations seem desirable with regard to the nominations.

The scheme, in the first place, provides that these nominations are to be limited generally to the First Lord, with certain privileges, elaborately set out, conferred upon individual members of the Board, secretaries, flag officers, commodores and captains. This looks too much as if the Navy were looked upon as an Admiralty preserve. We can imagine, although Sir Michael Hicks-Beach has so far made no revelations with regard to the Navy, that the officers who have to look after promotions may think, as we think, that the nominations should be exclusively in the hands of the First Lord and of the Prime Minister, for it is a question of the whole country with all its interests. The principle of heredity may be pushed too far, for captains will be admirals when their nominees come up for promotion as commanders, and this fact is quite enough, human nature being what it is, to suggest how undesirable the so-called privileges are.

Then comes another point. The payment for each cadet entered is 75*l*. per annum, but the Lords of the Admiralty reserve the power of reducing this to 40*l*. in the case of sons of naval, army, or marine officers, or of the civilian staff at the Admiralty.

If the whole Navy and Army, why not the whole Civil Service? and, indeed, why limit the concession to the public services when good cause can be shown for an extension? The more rigid the limitation the less certain the capture of future Nelsons, and the more justification will be given to a possible outcry that the Navy is being made a close preserve for the well to do.

Were the limit extended, a natural sequel would be to enter originally for the *Britannia* a larger number of boys—say some 30 per cent.—than would be wanted for the service, admitting the required number of these to the service by strict open competition at the end of the *Britannia* period and rejecting the rest. In this way, some objections to the nomination system at entry will be met. If only a few are rejected as under the proposed scheme it would be a stigma, whereas if the number is larger it would only be considered a misfortune, and the rejected would have had the best education in England, one fitting them for any walk in life, as we shall show.

We can have nothing but praise for the subjects chosen for the examination for entrance to the *Britannia*, which are as follows:—

PART I.

(1) English (including writing from dictation, simple composition, and reproduction of the gist of a short passage twice read aloud to the candidates).

(2)—(*a*) History and (*b*) Geography—
- (*a*) History (simple questions in English History and growth of the British Empire).
- (*b*) Geography (simple questions, with special reference to the British Empire).

(3) French or German (importance will be attached to the oral examination).

(4)—(*a*) Arithmetic, and (*b*) Algebra—
- (*a*) Arithmetic (elementary, including vulgar and decimal fractions).
- (*b*) Algebra to simple equations, with easy problems.

O

(5) Geometry (to include the subject-matter of the first book of Euclid, or its equivalent in experimental geometry and mensuration. The use of instruments and of algebraical methods will be allowed).

PART II.

(One only to be taken.)

(6) Latin (easy passages for translation from Latin into English and from English into Latin, and simple grammatical questions).
(7) A second modern language (of which, if not French or German, notice must be previously given), or an advanced examination in the language selected under Part I.
(8) Experimental science (easy questions with the object of testing practical knowledge and powers of observation).

The cadets are to remain four years in the *Britannia*, the instruction comprising an extension of the present course there, and we rejoice at the promise that the present one hour a fortnight for physics is to be replaced by a "thorough elementary instruction in physics and marine engineering, including the use of tools and machines." This, of course, means that there are to be laboratories and practical work, for book-work alone in such subjects is next to useless. Part of this instruction is also to be carried out afloat.

Such a course as this must not only give the cadets a good grounding in the subjects necessary to their profession, but such a mental training as is sure to lead to that brain-power which lies at the root of all good organisation and administration.

After these four years, the cadets will go to sea and become midshipmen. We are told in Lord Selborne's memorandum,

"Special attention will then be paid to their instruction in mechanics and the other applied sciences and to marine engineering. The instruction of the midshipmen in seamanship will be given, as at present, by an executive officer deputed by the captain; otherwise it will, under the general responsibility of the captain, be supervised by the engineer, gunnery, marine, navigating and torpedo lieutenants of their respective ships; they will be examined annually as to their progress in seamanship, navigation and pilotage, gunnery, torpedo work and engineering, all set papers being, as at present, sent from the Admiralty."

At the end of three years, every midshipman who has passed the qualifying standard at the last annual examination and the final examination in seamanship will become an acting sub-lieutenant, and if abroad return to England and proceed to the College at Greenwich for a three months' course of mathematics, navigation and pilotage, followed by an examination, and afterwards to Portsmouth for a six months' course in gunnery, torpedo and engineering, at the close of which he will be examined, and on passing out be confirmed in the rank of sub-lieutenant.

How the cadets are to be sent to sea is not yet settled. Either they will serve for the whole three years as midshipmen to battleships and cruisers, ordinarily commissioned, or the first part of this period will be passed in specially commissioned training ships. It is quite decided that at whatever period they are posted to ordinarily commissioned battleships and cruisers, compulsory school on board these ships shall cease.

The young officers who will pass out of the college at Portsmouth between the ages of nineteen and twenty will all have received exactly the same scientific training, and will have had opportunities of displaying their powers of organisation and of dealing with men.

We are not yet told what the common training is to be at Greenwich or at Portsmouth. We believe the present course for sub-lieutenants is somewhat as follows:—

PART I.

Length of course ... ... 8 weeks.

Subjects.		
Mathematics ...	Trigonometry, Mechanics, Navigation, Instruments.	21 hours a week.
Steam		2 ,,
French		2 ,,
Surveying		3 ,,
Physics		3 ,,
		31

PART II.

Length of course ... . 11 weeks.

Mathematics	Advanced Pure Maths, Statics, Hydrostatics, Dynamics, Navigation.	27 hours a week.
Physics		1 hour lecture. 3 ,, practical.
		31

PILOTAGE.

Length of course ... ... 6 weeks.
28 hours a week.

Now the differentiation begins. It seems to be as follows:—

Executive officers — Special navigation, ,, gunnery, ,, torpedo, Unspecialised,
Engineer officers,
Royal Marine officers,

and the object to be kept in view is stated to be to make them fit to perform those specialised duties which are the product of modern science; nothing is said about those officers who have no specialised duties.

The Executive Branch.

On this differentiation, all officers ranking as sub-lieutenants will go to sea for two years.

The next phase is that after two years at sea all the executive sub-lieutenants will be promoted to the rank of lieutenant on gaining the same qualifying watch-keeping certificate as at present. All those who have passed their examinations exceptionally well will, as now, receive accelerated promotion. Then comes a selection by the Admiralty of those among them who are to be trained as specialists in gunnery, torpedo work or navigation; these will go to the Royal Naval College at Greenwich for special courses. We presume that this "selection" for training as specialists represents a promotion for those so selected.

After five years' seniority in the rank of lieutenant, all officers will have to pass an examination for promotion to the rank of commander in certain technical subjects.

These are :—

Court-martial procedure,
International law,
Knowledge of British and foreign warships, guns, torpedoes, &c.,
Naval history,
Signals,
Strategy,
Tactics and battle formation.

This examination as it exists at present in the scheme is to be undergone alike by those who are engaged in the specialised scientific duties in the ship, with all their responsibilities, and those—under existing practice a much larger number—who have under the scheme no specialised scientific duties. Now it is obvious that these latter will be under much better conditions for preparing for an examination, and that the former will have no opportunity of letting their specialised duties tell in the examination, so that the effect of it will be to favour the promotion of those who were not selected to perform specialised duties.

The Engineer Branch.

On this differentiation, the engineer officers, sub-lieutenants about the age of nineteen, instead of going to sea for two years like the executive officers, will go to the college at Keyham for a professional course, the exact duration of which will be subsequently determined. At the expiration of this course, a proportion will be selected to go to Greenwich for a further course, while the remainder go to sea. They will then, if found qualified, all be promoted to be lieutenants under the same conditions as the executives. The nature and duration of the special course at Greenwich will be very carefully determined, and an opportunity will be afforded to those officers selected for it to make themselves acquainted with the latest developments of engineering science, not only at Greenwich, but at the great civil engineering establishments and institutions which are to be found in the country.

The engineers are now to be put on an equality with the executive officers, the ranks and uniform being assimilated, but with a difference, for while the executive officers specially trained for navigation (N), gunnery (G) and torpedo (T) lose these letters when promoted to be captains, the engineers are to retain the special (E) to the rank of Rear-Admiral (E), and as a solatium for not being allowed to command a ship are to receive higher pay and are promised "high appointments." Whether this arrangement will be carried out when the time comes, some twenty years hence, the future will show. In all the discussions on the complexity of the machinery of the modern man-of-war, the as great or greater complexity of the old sailing three-decker seems to have been entirely lost sight of.

The Royal Marines.

With regard to the sub-lieutenants drafted to the Royal Marines, we read as follows :—

"After his final examination as sub-lieutenant along with the future executive and engineer officer, the young Royal Marine officer will receive his special military training during the next two years partly at the college at Greenwich and partly at the headquarters of divisions or the depôt ; the training of all these officers will be extended so as to correspond more closely to the training now received by the young officers of the Royal Marine Artillery ; and after this two years' training, the young Marine officer will receive the rank and pay of lieutenant of marines so as to put him financially on an equality with the executive sub-lieutenant. As in the case of the executive lieutenants, specially good officers will qualify as gunnery and torpedo lieutenants, provided that they have kept watch at sea for one year, have passed the test examination for qualifying for gunnery and torpedo lieutenants, and have been specially selected and recommended. . . . The future Royal Marine officer will thus become available for keeping watch at sea and for general executive duties on board ship up to and including the rank of captain of marines."

Such is a short abstract of a scheme which we believe will be of the utmost value to the Naval Service. Educationally and scientifically, it has so much to recommend it that its authors, and chief among them, Lord Rosebery tells us we must hold Sir John Fisher, are to be warmly congratulated.

Only one conclusion can be drawn from the scheme as a whole ; many of the anticipated difficulties will have vanished before it comes into full operation some ten years hence, and the effect of the practical work in pure science now to be generally introduced for the first time, and the opportunities the officers will have of becoming acquainted and being responsible for every class of duty, both scientific and administrative, will weld them into a homogeneous body each member of which should have had his brain-power so thoroughly developed that the greatest scientific skill will generally be combined with the highest powers of organisation. At present, it would seem, the very opposite is the case, for otherwise the present Admiralty system of promotions cannot be defended. Nor is the difference in the treatment of the various branches limited to the promotions. Certain lieutenants are at present selected for certain specially scientific duties ; this leaves a large residuum not so selected. Special allowances are given to the navigating, gunnery and torpedo lieutenants in a ship, but the first lieutenant, who may be taken as the representative of the large body of non-specialists, not only gets a smaller allowance, but has to spend money in eking out the Admiralty's meagre supply of paint.

The allowance paid to the navigating officer is the highest, and it might be assumed, therefore, that his duties are considered important ; but what happens to him? We are informed that of 187 commanders promoted captains between June, 1892, and June, 1902, only 16, that is 1 in 11, have specially studied navigation and all that navigation means, and had the real handling of battleships in tactical exercises. Further, that these 16 have been promoted so late that none of them, in ordinary circumstances, can become admirals on the active list.

Recent sad experiences both with flag-ships and smaller craft—100 "accidents" to torpedo boats and t.b.d.'s in two years—have taught us that the best admiral and the best commander even of a torpedo boat will be he who knows most about what ships can do in various circumstances and how to make them do it. The most instructed navigator will always be the safest tactician. Leading a great fleet into action and drilling men in the

duties performed in a single ship are vastly different affairs.

The present system, however, as we have seen, bars the promotion of a navigating officer to the higher ranks. So that all the admirals, the future leaders of our battle fleets, eventually to be selected from among the 187 captains to whom we have referred, will be the least instructed and least practised in navigation and all that navigation means in the way of handling ships.

We are told that information with regard to the promotion of gunnery and torpedo officers is much more difficult to obtain, but this is of little importance, as their functions are necessarily limited to single ships and can have no bearing on tactics or the leading of fleets into action.

To the plain man, this result seems curious. Other reasons than that we have suggested have been given, but whatever the reason may be—we are not concerned either to attack or defend the Admiralty—we may hope that under the new system the apparent paradox will disappear, and it seems a pity to wait until then.

There is one part of the scheme of instruction which calls for criticism in a scientific journal. We read of special schools of gunnery, engineering and torpedo work, but no school of navigation is referred to.

It is a question whether an officer who has been generally trained and has been six years at sea will derive any benefit from going to a land college to learn navigation. What is really wanted to complete the scheme on true scientific lines is a navigation school afloat at this period of the officer's career where each member of the batch could take charge, under proper supervision of course, not only in tideways and strong currents, among traffic and in entering and leaving harbours, but in the open Atlantic.

This condition might be utilised by sending Marconi ethergrams, which would not only enable the Meteorological Office vastly to improve its service, but would give the young officers an interest in meteorology, a science which is still important to those who go to sea, though we find no reference to it in the memorandum.

Another important point that would be gained by this method of procedure would be to teach the officer that the roll of his ship will depend to some extent upon its presentation to the sea running at the time, so that there will be courses on which the fighting platform can be made more stable than on others. With homogeneous fleets, this may replace the "getting to windward" of old days preparatory to a naval engagement.

A PSYCHOLOGIST ON EVOLUTION.

Development and Evolution; including Psychophysical Evolution, Evolution by Orthoplasy, and the Theory of Genetic Modes. By James Mark Baldwin, Ph.D. Princeton, Hon. D.Sc. Oxon., LL.D. Glasgow, Stuart Professor in Princeton University. Pp. xvi + 392. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 10*s.* 6*d.* net.

THE theory of evolutionary method to which the name of "Organic Selection" has been generally applied was independently originated by Profs. Baldwin, Osborn and Lloyd Morgan. It has been accepted in its main features by many leading biologists, who see in it a probable interpretation of numerous facts which have hitherto been felt as difficulties in the way of the Darwinian explanation of evolutionary processes. It has even been considered to afford a prospect of reconciliation between the Neo-Lamarckians and the impugners of the hereditary transmission of acquired characters, though there can be no doubt that for the former party its adoption would mean nothing less than the surrender of the central citadel of their position.

In the present volume, Prof. Baldwin has not only given a detailed account of the theory in all its bearings, but has also brought together in the form of appendices the original statements of the same principle by Osborn and Lloyd Morgan, besides valuable comments by other authorities, including Prof. Poulton, Prof. Conn and Mr. Headley. The reader of "Development and Evolution" is thus furnished with ample material for forming a judgment on the significance of the views summed up under the general headings of "Organic Selection" and "Orthoplasy."

The relation of these views to the theories that may be roughly grouped as "preformist" on the one hand and "Lamarckian" on the other is stated by Prof. Baldwin with admirable clearness as follows:—

"If we give up altogether the principle of modification by use and disuse, and the possibility of new adjustments in a creature's lifetime, we must go back to the strictest preformism. But to say that such new adjustments influence phylogenetic evolution only in case they are inherited is to go over to the theory of Lamarckism. Now the position is that these individual adjustments are real (*versus* preformism), that they are not inherited (*versus* Lamarckism), and yet that they influence evolution. These adjustments keep certain creatures alive, so put a premium on the variations which they represent, so 'determine' the direction of variation and give the phylum time to perfect as congenital the same functions which were thus at first only private accommodations. Thus the same result may have come about in many cases as if the Lamarckian view of heredity were true. The general principle, therefore, *that new adjustments effected by the individual may set the direction of evolution without the inheritance of acquired characters* is what was considered new and was called organic selection." (Italics Prof. Baldwin's.)

In claiming elsewhere that the "broader principle of organic selection from certain points of view is new," the author is careful to allow that it was not only in some degree foreshadowed by Darwin, but that in the special instance of "social heredity" (better called "social transmission") its importance has been emphasised by Wallace and other writers. "Of course, to us all," as Prof. Baldwin says, "'newness' is nothing compared with 'trueness'"; nevertheless, the credit undoubtedly belongs to him of having independently discerned the real significance in evolution of individual adjustments, and of having been perhaps the first to put the relation between ontogeny and phylogeny, and between organic and social evolution, on a basis that should be satisfactory at once to the biologist and the philosopher.

It must not be forgotten that Prof. Baldwin is primarily a psychologist, and is apt to consider evolutionary questions largely from the psychological standpoint. In expounding his idea of the "psychophysical unit"; in his

revision (to our mind abundantly justified) of Herbert Spencer and Bain's theory of "overproduced movements" in mental ontogeny; and especially, perhaps, in the tracing of his own theory of knowledge to its outcome in the doctrine of "genetic modes," he often uses a notation which to biologists as such may seem somewhat unfamiliar. No one, however, who is at the pains to follow him through his chains of argument, often intricate, but with few exceptions consistent and intelligible, will be inclined to deny the great service he has done in submitting the problem of organic development to philosophical analysis.

It will be satisfactory to those biologists who still regard Darwin and Wallace as the true founders of a rational theory of evolution that the author, in demonstrating the inadequacy and improbability of use-inheritance, and in rightly laying stress on the importance of individual adjustment and of social transmission, does most explicitly assert the dominance of natural selection. "The value of accommodation," he allows, "is implicit in the theory of natural selection," and in more than one place (as in chapter xii., with its comprehensive table of the various kinds of "selection") he expresses his concurrence with Prof. Poulton's statements to the same effect. There is thus no room to doubt of his attitude towards the general question; but it is somewhat surprising, and, we think, regrettable, that in the case of the "highest and most specialised form of accommodation," viz., the intelligence, Prof. Baldwin speaks of the resulting "emancipation from the operation of natural selection and from dependence upon variations" in a way that seems open to misconstruction. There can be no such emancipation in the long run. *Naturam expelles furcâ, tamen usque recurret.* Whatever allowance we make for individual adjustment to environment, whether it be intelligent or not, there will be no reason to say that "the struggle for existence is in some degree done away with" unless we limit our outlook to variations other than variations in plasticity. It is true that the struggle is transferred "in some degree" to the sphere of the latter, but the "direct action of natural selection" is not thereby evaded. All individuals but a few (comparatively) are still eliminated in virtue of the same failure of correspondence with the environment; only this failure is, or may be, in the individual's power of accommodation, not in his invariable or fixed endowment. If, on the other hand, we were to hold, as Prof. Osborn seems to do, that this plasticity is an inherent power or function of protoplasm undirected and uncontrolled by natural selection, we should, of course, find ample reason for Prof. Baldwin's expressions. But he makes it elsewhere perfectly clear that he differs on this point from Prof. Osborn, and we therefore think that he would do well on a future occasion to avoid the appearance of putting plasticity, in its relation to selection, on a footing distinct from that of other qualities. It would be hard to show that any characteristic property of protoplasm did not take its share in the "fundamental endowment of life" and was not "part of its final mystery." Where, then, is the justification for claiming an exemption for one property which is not claimed for all?

We should have much more to say, did space permit, in commendation of this excellent and stimulating book. Many of the points raised are enticing subjects for discussion, but those features that call for adverse criticism are few in number and of little importance. The plan of the work, several chapters of which have already appeared under other conditions, necessarily involves a certain want of system and concentration; nor must the reader expect to find all that deals with one part of the subject gathered into one place. On the other hand, the author is enabled to enforce his arguments by repetition, and, as a sentence in his preface reminds us, "to the psychologist, at least, repetition has its pedagogical justification."

F. A. D.

A HISTORY OF AËRONAUTICS.

Travels in Space. By E. Seton Valentine and F. L. Tomlinson. With an Introduction by Sir Hiram S. Maxim. Pp. 328; with about sixty illustrations. (London: Hurst and Blackett, 1902.)

IT appears to be a growing practice in this country to publish books with a preface by some man of distinction, whose name figures prominently on the cover. It is a pity that publishers cannot agree to discountenance this practice. Either a book is worth reading without the recommendation or it is not worth reading even with it. Not but what the introduction in this case is worth reading.

The task which Messrs. Valentine and Tomlinson have had before them has been no easy one. They have no doubt derived considerable help from the French "Histoire des Ballons" and other books of a similar character, but even with that help they must have had to wade through a large mass of literature and then to sum up the principal points in a very short compass, all of which takes much time. The authors are greatly to be congratulated on the success with which they have completed their undertaking. The designs of Leonardo da Vinci, the fantastic project of Lourenco, the abortive attempts at flight by Besnier and De Bacqueville, the balloon ascents of Montgolfier, Pilatre de Rozier, Blanchard, Nadar, the impossible air-ships of Pétin and De Landelle, the actual glides of Lilienthal, Pilcher, Chanute, Santos Dumont rounding the Eiffel Tower, the *Pax* disaster, all these give a very inadequate idea of the large number of designs, projects, ascents, descents, successes, failures and fatalities described in these pages. There are few people so well versed in the history of aërial navigation that they would not learn something new and interesting on reading the present volume.

The authors confine themselves to the task of chronicling and describing, and do not indulge in lengthy speculations as to the future of the flight-problem. Seeing how uncertain that future is, they have acted wisely. At the same time, Sir Hiram Maxim points out that the book may have a useful purpose in the near future in preventing others from repeating experiments that have previously been tried and failed. The list of aëronauts who have met their death as the result of their aërial experiences since 1783 should be a warning to future experimenters or would-be experimenters. Theoretical considerations, numerical calculations and mathematical formulæ lie outside the scope of this book.

A reviewer usually likes to point out omissions, but the only one as yet noticed is that of the very recent experiences of Wilbur Wright and his brother. And evidently there are two accounts of Degen's attempts, of which the more improbable one is here given. According to the other, his machine would not rise until he attached it to a balloon.

The illustrations are excellent, but it may be as well to warn the reader that when he sees a picture of an aëronaut sailing over houses, trees, mountains, rivers and even pyramids in an extraordinary looking machine, it is not to be supposed that the journey depicted was ever performed, or even that the machine was necessarily constructed in the forms shown. Readers of the "Histoire des Ballons" will remember the fantastic figures of flying men in that book and will not be surprised to find a few of the types reproduced here, but now that experiments have been successfully made in directed navigation through the air, it would be well if some indication could be given on illustrations in future books showing at a glance whether the flight which they depict is a real flight or a mere flight of the imagination.

G. H. BRYAN.

TERRESTRIAL MAGNETISM.

United States Magnetic Declination Tables and Isogonic Charts for 1902. By L. A. Bauer. Pp. 405. (Washington: Government Printing Office, 1902.)

THE activity of the United States Coast and Geodetic Survey Department in carrying out a magnetic survey of the States and outlying territories has long been a subject of interest to magneticians, and in this book we have the first complete information on the results of that survey up to January 1, 1902, as regards the one element magnetic declination.

Tables, giving every observation made, occupy 142 pages, including positions, date of observation, values observed and values reduced to 1902, followed by the name of the observer or authority. The succeeding 138 pages are devoted to descriptions of the magnetic stations occupied by the Survey between 1881 and July, 1902.

The accompanying chart of "Lines of Equal Magnetic Declination" is based on the results plotted at about 5000 points, embodying all the latest declination data of known value. The lines are true isogonals, drawn with considerable sinuosities, representing the results of actual observation and showing disturbances from normal values, but as these latter have not yet been calculated, the amount of disturbance and the centres of disturbance have not been ascertained. The chart for Alaska gives normal lines of the magnetic declination calculated from all available observations, there being too few of the latter from which to draw true isogonals.

A welcome addition to the tables and charts will be found in the opening chapter under the heading "Principal Facts relating to the Earth's Magnetism," showing our present state of knowledge of terrestrial magnetism and the vast field open to future observers and students of that branch of science.

In this chapter, the evolution of the compass is treated boldly and agreeably with the evidence of the best authorities, and one rather looks for the date and the name of the first person who applied that very important addition to the mariner's compass—its suspension in gimbal rings. It is clear that the use of this suspension was implied by Pedro de Medina in his "Arte de Navigacion" of 1545, and was accurately described as part of a compass by Martin Cortés in his "Arte de Navigacion" of 1556, but they leave the inventor's name in obscurity.

Turning to the subject of Gilbert's work, "De Magnete," the author remarks on the "intolerance and lack of appreciation of the work of his predecessors" shown by Gilbert. When, however, one reads the account given by the latter of the mass of ignorance and superstition he had to battle with and relinquish to "the moths and worms"—such as the medicinal properties of the lodestone and its uses as a detector of immorality and many other "vanities"—we can hardly wonder at their begetting a spirit of intolerance in him. Even "the Onyon and Garlick myth" which he so denounced was revived in 1885 by an inventor who proposed the use of the juice of the common Dutch red onion as a magnetic screen. Possibly some readers of the present work will think the author has not quite done full justice to Gilbert.

On p. 60, the authority of the late Prof. Eschenhagen is given for the statement that the effects of earthquakes on the magnetic needle are "entirely mechanical." As the more recent investigations of Prof. Milne point to an opposite conclusion, there is evidently room for further inquiry as to how far the disturbances observed are due to magnetic causes or not.

In the article on magnetic observatories, some useful details are given of the structure of the magnetic observatory at Cheltenham, Maryland, where, although it is built entirely above ground, the diurnal change of temperature has been reduced to a few tenths of a degree, and further reduction is looked for.

In conclusion, it may be remarked that some of the illustrations are taken from rare prints, and their reproduction cannot fail to be of great interest to many who may not have the means of seeing the originals. Pleased as the investigator may be with the valuable results contained in this book, he will look forward with enhanced interest to a similar publication relating to the magnetic inclination and force, both of which have been so extensively observed in the United States.

OUR BOOK SHELF.

Letters on Reasoning. By J. M. Robertson. Pp. xxviii + 248. (London: Watts and Co., 1902.)

THIS book is in the form of letters addressed to the author's children, and is lucidly and fluently written. Mr. Robertson's counsels upon the duty and importance of clear thought and scrupulous candour in reasoning are excellent, and it is to be hoped the children to whom the letters are addressed will profit by them. It is a pity Mr. Robertson does not always follow his own good advice. In the constant polemic against theism, to which he recurs in chapter after chapter, he often unconsciously misrepresents the case against which he is

arguing, and his own reasoning is not unfrequently vicious. Thus it is hardly fair to the advocates even of the crudest form of the "design" hypothesis to meet Paley's argument about the traveller who finds the watch in the desert with the retort that the argument assumes the desert at least to be "undesigned." All that is assumed is that the desert, whether "designed" or not, does not, like the watch, exhibit design of a specific kind recognisable by the traveller. And Mr. Robertson's own chief argument against theistic design, that an infinite series, such as the "totality of events," cannot have any specific predicates beyond the one predicate of "infinity," is surely very doubtful. If I can make predications about the infinite series of the natural numbers (such as, *e.g.*, that every member of it has a next term, that every member is commensurable with every other), why not of the infinite series of "events?" Similarly, the argument used in discussing psychological determinism, that no one predicate, such as, *e.g.*, "free," can be applied to all volitions, since they are an infinite series belonging to no wider species, is really fallacious. For in psychology the very need of a precise definition of a volition compels us to distinguish volitions from other psychical states, such as impulses, cravings, resolutions, and volitions thus come to be an infinite series, no doubt, but an infinite series of which the law of formation is known. The infinity of such a series in no way excludes specific predication about it. Mr. Robertson presumably thinks that the "totality of events" is a series of which we do not know the formative law. But this is just what he has to *prove* against the theist. He is not entitled to assume the point at issue as if it were a self-evident axiom of thought.

It is much to be regretted that the author allows himself to exhibit a zeal which too often degenerates into partisan rancour against his "religious" opponents. A man is not necessarily either dishonest or stupid because he holds opinions on these subjects other than those of Mr. Robertson, and Mr. Robertson does not strengthen his case by writing as if he were so. A. E. T.

Electro-plating and Electro-refining. By A. Watt and A. Philip. Pp. xxiv + 680. (London: Crosby Lockwood and Co., 1902.) Price 12*s.* 6*d.* net.

The late Alexander Watt's book on electro-deposition was well known as a standard work on the subject, but for some time it has been out of date both in subject-matter and in method of treatment. Mr. Arnold Philip, in editing and largely rewriting a new edition, has performed a service which was much required, but it is to be regretted that he has not been sufficiently thorough in his work of revision. Perhaps this is due to a desire on his part to retain as far as possible the form of the original book, but there can be little question but that by entirely recasting it and putting the vast amount of useful information it contains in a form more suited to modern ideas and developments he would have been performing a more valuable service. It is, for example, rather out of date to give instructions for carrying out different operations in terms of Wollaston, Smee, Daniell or other batteries. We hope that the number of electro-platers using such sources of electricity is at the present day small, but even if it is considerable it is eminently desirable that a book such as this should make use of scientific units. To take one other example, we were surprised to find that the section devoted to nickeling bicycles described the operations to be performed in taking to pieces an old-fashioned "ordinary" and entirely disregarded the existence of the modern safety or pneumatic tyres. Such a fault as this, possibly not of much importance in itself, has the grave defect of destroying the reader's confidence in the rest of the work; how is the student to feel sure that the numerous recipes and instructions are not as much things of the past as the solid-tyred ordinary?

Mr. Philip has, however, done much to improve Watt's book, especially in the chapters which he has added. Chapters ii. and iii. of the second part, dealing with the cost of electrolytic copper refining and with the many important details of that industry, are particularly to be commended. Taken altogether, this new edition is, like the older ones, a good and valuable book, and our only cause of complaint against Mr. Philip is that he has somewhat missed the opportunity of bringing it properly up to date. M. S.

The Teaching of Chemistry and Physics in the Secondary School. By Alexander Smith, B.Sc., Ph.D., and Edwin H. Hall, Ph.D. Pp. xiii + 377. (London: Longmans, Green and Co, 1902) Price 6*s.* net.

This book, which belongs to the American Teachers Series, is well worthy of the attention of those who are engaged in the teaching of chemistry and physics, whether in schools or universities. It contains an able and temperate discussion of nearly every important question of method that arises in connection with the teaching of chemistry and physics, and it has the great merit of being neither wordy nor pedantic. It will be a surprise to many English teachers to see how thoroughly this subject is being handled in America.

It is, unfortunately, not possible in the limits set to this notice to give illustrations of the treatment of the subject by the two American professors. If the book is read in this country as it deserves to be, it will tend to induce a more philosophical attitude towards the extremely difficult and important question of teaching physical science in the earlier stages. A. Smithells.

Index Zoologicus. By C. O. Waterhouse. Edited by D. Sharp. Pp. xii + 421. (London: Zoological Society, 1902.)

For the last twenty years, the "Zoological Record" has contained an appendix of the new generic and subgeneric names recorded annually in its pages. These lists have been combined, with the addition of such names of earlier date as were omitted from Dr. Scudder's "Nomenclator Zoologicus," published in 1882, and the result is the present volume, which includes the period from 1880 to 1900. The value of such a compilation to working zoologists cannot be overestimated, and the author and editor, as well as those gentlemen by whom they were assisted, by the completion of their laborious task have earned a debt of gratitude beyond the power of thanks to repay. The present volume includes about 40,000 names, of which some 6000 belong to the period before 1800; an idea may therefore be formed of the enormous rate at which new names are growing. Many of these, like those in earlier lists, are, of course, synonyms, but the editor is of opinion that some 80,000 generic and subgeneric names are actually used in zoology. A glance at almost any page in the volume before us will show that much still remains to be done in purging the list on account of the same name being used for two or more groups, but this did not come within the province of the compilers.

How near the list approaches completeness must depend to a great degree on the thoroughness, or otherwise, with which the various contributors to the "Zoological Record" have done their work. Personally, the writer feels responsible for at least one omission—the genus Dinocynops, proposed by Ameghino in 1898—and probably he is not the only offender. Such omissions detract, however, in no way from the careful and painstaking manner in which the compilers have executed their task, and we can but repeat our sense of the obligation under which they have placed all working naturalists. R. L.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Genius and the Struggle for Existence.

WILL you allow me to supplement the excellent reply of Sir Oliver Lodge to your correspondent Mr. G. W. Bulman by a few remarks dealing more specifically with that gentleman's difficulty, which is one very widely felt, but is, I believe, founded on a misconception?

The words "useful" and "advantage" have two distinct meanings, the one referring to material the other to intellectual and moral results; and it is in the former sense only that they can be properly used in relation to natural selection or survival of the fittest. In that relation, physical results only are of value—those that tend to the preservation of life on occasions of stress and danger. In deciding whether any quality, physical or mental, is of *value* in this sense, Lloyd Morgan's admirable test should be applied—"Is it of survival-value?" If not, then it is *not* useful in the struggle for existence either to the individual or the race, unless it happens to be combined with other qualities which are, in an exceptional degree, of survival value. Now genius in all its varying manifestations is a quality which has hardly any relation to survival except an adverse one, and only in exceptional cases is of any *material* advantage to the race. The genius of the poet, of the writer, of the artist, even of the inventor, only occasionally benefits the race in its material struggle with other races, while it very rarely gives long life and an ample progeny to the possessor. Its *use* to him is solely the enjoyment of the exercise of his faculty of creating. Too frequently it is of no material use whatever to him, and he dies in poverty and neglect. The two races that have exhibited the highest manifestations of genius were the ancient Greeks and the Jews. But this genius did not advantage their respective races in the struggle for existence. Both of them became permanently subject races, and that they have survived at all is not due to their genius, but to their exceptionally fine physical qualities, their courage and their endurance.

As a matter of fact, the law of the survival of the fittest has almost entirely ceased to apply to civilised man, and the more civilised he is the less it applies. I have already shown (in the chapter on "Human Selection" in my "Studies"), how, under a higher civilisation and a truer social system, it will be superseded by another law, which may be termed "the perpetuation of the fittest," and which will operate as automatically and as beneficially in improving the human race as natural selection has acted in improving the lower animals. At present, as Darwin himself fully recognised, it is not the best or the highest that survive, but a comparatively low type morally and intellectually, though in relation to our present very imperfect civilisation they may be held to be the fittest. It is, however, fitness to "succeed in life," as it is termed, not necessarily to survive; and this is indicated by the comparatively short lives of millionaires and of the inhabitants of cities, who are continually replaced by the sons of the less successful but more virile inhabitants of the rural districts. ALFRED R. WALLACE.

The Holy Shroud.

PROF. MELDOLA's notice from a truly scientific standpoint of Dr. Vignon's book, entitled "The Shroud of Christ," is not less interesting than valuable, but I think two difficulties which hardly fell within the scope of his article may also be raised. One struck me at once in examining the facsimile of the photographic negative plate of the Holy Shroud (facing p. 17). The body had been lying, of course, face upwards. I presume that if a corpse were thus placed on a stone slab, within a very few hours of death, the nates would be slightly flattened by pressure, but their normal roundness—as in a nude standing figure—caught my eye at once when examining the plate.

But a still more serious difficulty awaits Dr. Vignon. The shroud in shape has a general resemblance to an elongated bath-towel; on one half, smoothed out, the body was laid, and the other was neatly doubled over the head and brought down so as completely to cover the feet. This mode of burial, so far as I know, was not usual among the Jews at that date (the corpse being more or less wrapped up, as described in the raising of Lazarus). But passing over this point, for Dr. Vignon pleads that the arrangement was a temporary one (though, by the way, it would make the preservative myrrh and aloes much less effective), we find the authors of the four Gospels all use language which excludes any such arrangement of the so-called shroud. Matthew and Luke both write ἐνετύλιξεν αὐτὸ ἐν σινδόνι; Mark in a nearly identical sentence substitutes the verb ἐνείλησεν. But both these words mean to wrap or to roll up, not to lay a sheet over (and under). John, in a rather more minute description, says, ἔδησαν αὐτὸ ἐν ὀθονίοις μετὰ τῶν ἀρωμάτων, adding "as is the custom of the Jews in burial." He also mentions bandages or body-cloths a second time, and a napkin bound about the head—which would have interfered with the photographic process. Dr. Vignon endeavours to elude the plain meaning of these passages, but, as it seems to me, he can only prove the genuineness of the shroud by rejecting the four principal witnesses to the facts of which it is supposed to be a record, a process which has a suspicious resemblance to sawing off the branch on which you are sitting. T. G. BONNEY.

The Herbarium of Ferrante Imperato at Naples.

IN a recent issue of NATURE (vol. lxvii. p. 181), there is an account of a paper by Prof. B. Schorler on a history of systematic botany prior to Linnæus. In the list given of the most ancient existing herbaria, no mention is made of that of Ferrante Imperato, which is among the oldest extant. This ancient herbarium, the remains of which are preserved in the National Library of Naples, is also overlooked in the interesting paper, now in course of publication, in the *Magyar Botanikai Lapok* (Budapest, 1902), by Alföldi Flatt Károly, "Zur Geschichte der Herbare."

An incidental notice of the herbarium of Ferrante Imperato was published by me in NATURE (vol. lxiii., November, 1900) in an article on Domenico Cirillo and the chemical action of light, in connection with vegetable irritability.

Ferrante Imperato, a Neapolitan *simplicista*, born in 1550, lived in Naples, where he died in 1625. In those days, museums of natural history began to be formed in Italy, the most famous being those of Aldovrandi in Bologna, the museum of Pisa, where Andrea Cesalpino (1519-1603) taught, and the museum of Ferrante Imperato in Naples. In Ferrante's book, "Dell' Historia Naturale, Libri XXVIII.," edited by his son, Francesco Imperato, in 1599, is given a picture of the museum at Naples. This museum, as the author says, contained "Natural plants artificially preserved, attached to the pages of special books, and besides, terrestrial, aquatic and flying animals: moreover, gems, marbles and divers stones, earths, minerals and metals, and preserved seeds and rare leaves, and extracts of divers earths and plants."

At the end of the sixteenth century, a Genoese nobleman, Giovanni Vincenzo Pinelli, formed in Naples a botanical garden or "Orto dei Semplici," in which many rare plants were collected under the care of Bartolomeo Maranta, of Venosa (who died in 1570), Ferrante Imperato and Fabio Colonna (1567-1650), an active correspondence and exchange of materials being kept up with other collectors. As Imperato puts it in his book, "human sciences grow by communion among men; this do I say and confess because our studies and the matters of which we write have developed by the help of friends who have concurred in procuring for us things from divers parts of the world, or have been companions and fellow-labourers." Besides G. V. Pinelli, the chief helper in collecting foreign objects, and Maranta and Fabio Colonna, who lived in Naples, Imperato records among his correspondents Pietro Andrea Mattioli, of Siena (1500-1577), Melchiorre Guilandini, of Padua (1520-1589), Jacopo Cortuso, also of Padua (1513-1603), Ulisse Aldovrandi, of Bologna (1522-1605), Carlo Clusio, Kaspar Bauhin, of Bâle (1560-1624), and Colantonio Stelliola, "Professor of Recondite Sciences, to whom I have communicated the greater part of the discoveries made by me." One does not understand why some authors attribute the work of Imperato to this Stelliola.

The herbarium was perhaps the more important part of this Neapolitan museum, being contained in eighty volumes. The museum of Imperato got dispersed during the great plague of Naples in 1656, and only nine out of the eighty volumes of the

herbarium were saved, passing into the hands of Nicola Cirillo (1671–1734), a physician and botanist who possessed a private botanical garden and was a Fellow of the Royal Society of London, for which Society he collected data on the climate of Naples, and wrote a treatise on the application of cold in the treatment of fevers. Remaining in the Cirillo family, the herbarium was finally bequeathed to the celebrated botanist Domenico Cirillo, who preserved these volumes as the most precious treasure in his collections. In 1783, Martin Vahl, a friend of Linnæus, saw Imperato's herbarium in Cirillo's house, and it is said that he fell on his knees in reverence before the ancient relic. In 1799, when the royalist mob sacked Cirillo's house and Cirillo himself was hanged, all his collections were dispersed, including the herbarium of Imperato. Of the nine volumes only one was saved, and finally came into the hands of Camillo Minieri-Riccio, who in 1863 published a short account of this botanical relic (C. Minieri-Riccio: "Breve notizia dell' Erbario di Ferrante Imperato," *Rendiconti dell' Accademia Pontaniana*, xi., 1863). Minieri says that Imperato's name is written in the volume.

The collections of Minieri-Riccio were finally sold to the National Library at Naples, where the volume of Imperato's herbarium may now be seen.

The volume, of 268 pages, is bound in parchment and is labelled "Collectio Plantarum Naturalium." It contains 440 plants, glued to the paper, each with one or more names. There is an alphabetical index, probably written by Imperato himself.

The authorities in the Naples library do not seem aware of the importance of the relic they possess, for the herbarium is kept as an ordinary book and the plants are exposed to inevitable damage and decay. Several of the specimens have already been eaten up by insects. ITALO GIGLIOLI.

R. Stazione Agraria Sperimentale, Rome, January 8.

A Curious Projectile Force.

I AM able to corroborate B.A. Oxon.'s letter (p. 247). In my case, the screw stopper of the bottle (inverted) rested at an angle against some books on a table. When the pressure of the gas was sufficient to force out the stopper, the bottle sprang three or four feet into the air and fell some distance off on the floor of the room. NORMAN LOCKYER.

The Principle of Least Action. Lagrange's Equations.

WHETHER good mathematicians, when they die, go to Cambridge, I do not know. But it is well known that a large number of men go there when they are young for the purpose of being converted into senior wranglers and Smith's prizemen. Now at Cambridge, or somewhere else, there is a golden or brazen idol called the Principle of Least Action. Its exact locality is kept secret, but numerous copies have been made and distributed amongst the mathematical tutors and lecturers at Cambridge, who make the young men fall down and worship the idol.

I have nothing to say against the Principle. But I think a great deal may be said against the practice of the Principle. Truly, I have never practised it myself (except with pots and pans), but I have had many opportunities of seeing how the practice is done. It is usually employed by dynamicians to investigate the properties of mediums transmitting waves, the elastic solid for example, or generalisations or modifications of the same. It is used to find equations of motion from energetic data. I observe that this is done, not by investigating the actual motion, but by investigating departures from it. Now it is very unnatural to vary the time integral of the excess of the total kinetic over the total potential energy to obtain the equations of the real motion. Then again, it requires an integration over all space, and a transformation of the integral before what is wanted is reached. This, too, is very unnatural (though defensible if it were labour-saving), for the equation of motion at a given place in an elastic medium depends only upon its structure there, and is quite independent of the rest of the medium, which may be varied anyhow. Lastly, I observe that the process is complicated and obscure, so much so as to easily lead to error.

Why, then, is the P. of L. A. employed? Is not Newton's dynamics good enough? Or do not the Least-Actionists know that Newton's dynamics, viz. his admirable Force = Counter-force and the connected Activity Principle, can be directly applied to construct the equations of motion in such cases as above referred to, without any of the *hocus pocus* of departing from the real motion, or the time integration, or integration over all space, and with avoidance of much of the complicated work. It would seem not, for the claim is made for the P. of L. A. that it is a commanding general process, whereas the principle of energy is insufficient to determine the motion. This is wrong. But the P. of L. A. may perhaps be particularly suitable in special cases. It is against its misuse that I write.

Practical ways of working will naturally depend upon the data given. We may, for example, build up an equation of motion by hard thinking about the structure. This way is followed by Kelvin, and is good, if the data are sufficient and not too complicated. Or we may, in an elastic medium, assume a general form for the stress and investigate its special properties. Of course, the force is derivable from the stress. But the data of the Least-Actionists are expressions for the kinetic and potential energy, and the P. of L. A. is applied to them.

But the Principle of Activity, as understood by Newton, furnishes the answer on the spot. To illustrate this simply, let it be only small motions of a medium like Green's or the same generalised that are in question. Then the equation of activity is

$$\text{div. } \mathbf{q}\mathrm{P} = \dot{\mathrm{U}} + \dot{\mathrm{T}}\,; \tag{1}$$

that is, the rate of increase of the stored energy is the convergence of the flux of energy, which is $-\mathbf{q}\mathrm{P}$, if $\mathbf{q}$ is the velocity and P the stress operator, such that

$$\mathrm{P}\mathbf{i} = \mathbf{P}_1 = \mathbf{i}\mathrm{P}_{11} + \mathbf{j}\mathrm{P}_{12} + \mathbf{k}\mathrm{P}_{13} \tag{2}$$

is the stress on the $\mathbf{i}$ plane. Here $\mathbf{q}\mathrm{P}$ is the conjugate of $\mathrm{P}\mathbf{q}$.

By carrying out the divergence operation, (1) splits into two, thus

$$\mathbf{F}\mathbf{q} = \dot{\mathrm{T}}, \qquad \mathbf{G}\mathbf{q} = \dot{\mathrm{U}}. \tag{3}$$

Here $\mathbf{F}$ is a real vector, being the force, whilst $\mathbf{G}$ is a vector force operator. Both have the same structure, viz. $\mathrm{P}\nabla$, but in $\mathbf{F}$ the differentiators in ∇ act on P, whereas in $\mathbf{G}$ they are free and act on $\mathbf{q}$, if they act at all.

Now when U is given, $\dot{\mathrm{U}}$ becomes known. It contains $\mathbf{q}$ as an operand. Knock it out; then $\mathbf{G}$ is known; and therefore $\mathbf{F}$; and therefore the equation of motion is known, viz.

$$\mathbf{F} = \frac{d}{dt}(m\mathbf{q}),$$

where m is the density, or the same generalised eolotropically, or in various other ways which will be readily understood by electricians who are acquainted with resistance operators.

Of course, P becomes known also. So the form of U specifies the stress, the translational force and the force operator of the potential energy. To turn $\mathbf{G}$ to $\mathbf{F}$ is the same as turning $\mathrm{A}\dfrac{d}{dx}$ to $\dfrac{d\mathrm{A}}{dx}$.

If, for example, the displacement is $\mathbf{D}$, the potential energy is a quadratic function of the nine differentiants $d\mathrm{D}_1/dx$, &c., of the components. Calling these r_{11}, r_{12}, &c.;

$$\mathrm{U} = \tfrac{1}{2}r_{11}\frac{d\mathrm{U}}{dr_{11}} + \tfrac{1}{2}r_{12}\frac{d\mathrm{U}}{dr_{12}} + \ldots, \tag{4}$$

by the homogeneous property. Therefore, since $\dot{r}_{12} = dq_1/dy = \mathbf{i}d\mathbf{q}/dy$,

$$\dot{\mathrm{U}} = \left(\frac{d\mathrm{U}}{dr_{11}}\mathbf{i}\frac{d}{dx} + \frac{d\mathrm{U}}{dr_{12}}\mathbf{i}\frac{d}{dy} + \ldots\right)\mathbf{q} = \mathbf{G}\mathbf{q}\,; \tag{5}$$

therefore, writing P_{21} for $d\mathrm{U}/dr_{12}$,

$$\mathbf{F} = \mathbf{i}\left(\frac{d\mathrm{P}_{11}}{dx} + \frac{d\mathrm{P}_{21}}{dy} + \frac{d\mathrm{P}_{31}}{dz}\right) + \ldots \tag{6}$$

$$= \frac{d\mathbf{P}_1}{dx} + \frac{d\mathbf{P}_2}{dy} + \frac{d\mathbf{P}_3}{dz}. \tag{7}$$

It is clear that the differentiants in (4) (which involve the large number 45 of coefficients of elasticity in the general case of eolotropy) are the nine components of the conjugate of the stress operator. Of course, vector analysis, dealing with the natural vectors concerned, is the most suitable working agent, but the same work may be done without it by taking the terms involving q_1, q_2, q_3 separately.

Another expression for U is $\mathrm{U} = \tfrac{1}{2}\mathbf{G}\mathbf{D}$, which shows how to find $\mathbf{F}$ from U directly.

Another claim made for the P. of L. A. is that it leads to Lagrange's equations of motion. That is not remarkable, seeing that both are founded upon Newtonian ideas. I suppose Lagrange's equations can be made to lead to the P. of L. A. But the practical way of proving Lagrange's form is to derive it immediately from Newton's Principle of Activity. Thus, when there are n independent coordinates x, with velocities v, the kinetic energy T is a homogeneous quadratic function of the v's, with coefficients which are functions of the x's. This makes

$$2\mathrm{T} = v_1 \frac{d\mathrm{T}}{dv_1} + v_2 \frac{d\mathrm{T}}{dv_2} + \ldots ; \qquad (8)$$

therefore

$$2\dot{\mathrm{T}} = \frac{d}{dt}\frac{d\mathrm{T}}{dv_1} v_1 + \frac{d\mathrm{T}}{dv_1}\dot{v}_1 + \ldots . \qquad (9)$$

But also by the structure of T,

$$\dot{\mathrm{T}} = \frac{d\mathrm{T}}{dx_1} v_1 + \frac{d\mathrm{T}}{dv_1}\dot{v}_1 + \ldots . \qquad (10)$$

So, by subtraction of (10) from (9)

$$\dot{\mathrm{T}} = \left(\frac{d}{dt}\frac{d\mathrm{T}}{dv_1} - \frac{d\mathrm{T}}{dx_1}\right) v_1 + \ldots ; \qquad (11)$$

and therefore, by Newton, the force on x_1 is the coefficient of v_1, and similarly for the rest.

Some people who had worshipped the idol did not altogether see that the above contained the really essential part of the establishment of Lagrange's form, and that the use of the activity principle to establish the equation of motion is proper, instead of *vice versâ*. To all such the advice can be given, Go back to Newton. There is nothing in the P. of L. A., or the P. of L. Curvature either, to compare with Newton for comprehensive intelligibility and straight correspondence with dynamics as seen in Nature. It must, however, be said that Newton's third law is sometimes astonishingly misconceived and misapplied, perhaps because it is badly taught.

OLIVER HEAVISIDE.

Leonids of 1902, and Quadrantids of 1903.

CLOUDS and full moonlight seem to have impeded observations of the Leonids to a considerable extent in November, 1902. The night of November 14 was fine here, but as there seemed little probability of a display on that date—as is fully confirmed by the negative results of other observers—no extended watch was maintained. The night of November 15 turned out very unfavourable. It seemed unusually bright here about 6h. 30m. on the morning of November 16. No observations were possible in the circumstances. Even if the sky had been clear, very probably nothing unusual in the way of a meteor display would have been visible, owing to the presence of the full moon, then shining with almost maximum brilliancy. M. D. Eginitis, with three assistants, observing at Athens during the night of November 15, did not see more meteors—in fact, they counted one less—than on that of November 14, 1901, on which night the American maximum took place. Both those nights were clear, but possibly the observations may not have been equally extensive. The maximum of 1902 probably took place in America, but in the absence of reports of clear observations at a few stations on the other side of the Atlantic, it is difficult to gauge with certainty the character of the display.

The Quadrantid meteors, on the other hand, were well seen here, considering the broken character of the weather. Anticipating that the display of 1903 would occur early on the night of January 3—the maximum had been determined as due at 8h. 55m.—a watch was begun at 8h. 45m., and during the next hour or so some very fine meteors were observed. The following are the times of their appearance, and their approximate flights:—

	d.	h.	m.	
Jan.	3	8	53,	from 2° west of Gemini to Orion, = 1st magnitude.
,,	3	8	56,	,, 1° east of the "Guards" to Pole Star, = 1-2 magnitude.
,,	3	9	20,	,, between Castor and Pollux to Orion, = 1st magnitude.
,,	3	9	47,	,, between the "Guards" half-way to Pole Star, = 2nd magnitude.
,,	3	9	59½,	,, 20° west of "Guards" to 10° higher up, = rich streak.
,,	3	10	0,	,, 20° west of "Guards" to Cassiopeia, = Capella.

Shortly after 10 o'clock, clouds came up from the horizon and by 10h. 15m. the whole north-eastern sky up to Gemini was covered. At 10h. 35m., that part of the sky had again cleared, and, between 10h. 40m. and 10h. 55m., eight meteors, varying from about 1st to 2nd magnitudes, were observed. They were all long-pathed, but generally not so much so as the early part of the display, nor did they seem to move in beaten tracks, as it were, like the first meteors. The direction of their flight resembled, on the whole, that of the former, but one of them (= Sirius) shot downwards for about 30° in a direction parallel to the tail stars of Ursa Major. It started from a point about 20° east of that constellation. The latter part of the display between 10h. 40m. and 10h. 55m. was the richest I have ever observed. I observed no meteors, except one or two between 9 and 10 o'clock, that could not be traced. They began to come so rapidly at 10h. 40m. that when making a note of the course of one, another would put in an appearance, and so prevent the completion of the first observation, their paths not being near any well-known stars. An interval of quiescence for a few minutes would then follow, when the phenomenon would be again repeated as before. At 11 o'clock, the sky became again clouded and a heavy shower of rain terminated open-air observation. Between 12h. and 12h. 20m., two more were seen through a window, of about the 3rd magnitude, one on either side of the tail stars of Ursa Major; then clouds once more intervened.

JOHN R. HENRY.

Dublin.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-second annual meeting of the American Association was held at Washington, December 29 to January 3, and was in many respects the most successful meeting ever held in the fifty odd years of the existence of the Association. As pointed out in the article in NATURE of July 24, 1902, in the account of the Pittsburg meeting of last June, this is practically the first time in which the Association has met during the winter since the close of the Civil War, and in this meeting culminated the prolonged efforts of a special committee of the Association, of which Dr. Charles Sedgwick Minot was chairman, to bring about an agreement among the scientific and other learned societies and the leading universities and other institutions of learning in the United States to set apart the week in which the first of January falls as a "Convocation Week," and in this week to bring together at one place as many as possible of the scientific societies. This culmination of the efforts of Dr. Minot's committee was eminently satisfactory. The meeting was a great success, and the institution of Convocation Week has apparently been established under the most favourable auspices.

Dr. Ira Remsen, president of Johns Hopkins University, presided over the Washington meeting, and the retiring president, the noted astronomer, Prof. Asaph Hall, U.S.N., delivered his address on the opening night of the session. His subject was "The Science of Astronomy," and it was published in full in our last week's issue.

The local arrangements for the meeting were complete, and the President of the United States acted as honorary president of the local committee, the active chairman being Dr. C. D. Walcott, Director U.S. Geological Survey, and the local secretary Dr. Marcus Benjamin, U.S. National Museum.

The addresses of the vice-presidents of the different sections were given in the afternoon of Monday, December 29, as follows:—

Prof. G. W. Hough before the Section of Mathematics and Astronomy, on "The Physical Constitution of the Planet Jupiter." Prof. Franklin before the Section of Physics, on "Limitations of Quantitative Physics." Prof. Weber before the Section of Chemistry, on "Incomplete Observations." Prof. Culin before the

Section of Anthropology, on "New World Contributions to Old World Culture." Prof. Welch before the Section of Physiology and Experimental Medicine. Prof. J. J. Flather before the Section of Mechanical Science and Engineering, on "Modern Tendencies in the Utilisation of Power." Prof. C. C. Nutting before the Section of Zoology, on "Some of the Perplexities of a Systematist." Prof. D. H. Campbell before the Section of Botany, on "The Origin of Terrestrial Plants." Prof. Wright before the Section of Social and Economic Science, on "The Psychology of the Labour Question."

Many important scientific bodies met in affiliation with the Association. Among these were:—The American Anthropological Association, the American Chemical Society, the American Folk-lore Society, the American Microscopical Society, the American Morphological Society, the American Philosophical Association, the American Physical Society, the American Physiological Society, the American Psychological Association, the American Society of Naturalists, the Association of American Anatomists, the Association of Economic Entomologists, the Astronomical and Astrophysical Society of America, the Botanical Society of America, the Botanists of the Central and Western States, the Geological Society of America, the National Geographic Society, the Naturalists of the Central States, the Society of American Bacteriologists, the Society for Plant Morphology and Physiology, the Society for the Promotion of Agricultural Science, the Zoologists of the Central and Western States.

The approximate register of scientific men and women in attendance at this series of meetings was fifteen hundred, of whom about one thousand registered for the American Association. The week was thus a very crowded one, the days being occupied with the meetings of the sections and the affiliated societies, and the general functions being as follows:—

On Monday evening, the annual address of the retiring president, Prof. Hall. Monday afternoon, the addresses of the retiring vice-presidents. On Tuesday evening, the address of the retiring president of the American Chemical Society, Dr. Remsen, and the public lecture of the American Society of Naturalists, delivered by Dr. C. Hart Merriam, on the subject "Protective and Directive Coloration of Animals, with especial Reference to Birds and Mammals." On the same evening, the Botanical Society of Washington gave a reception to visiting botanists. On Wednesday afternoon, the annual discussion of the American Society of Naturalists was held; the subject was "How can Endowments be Used most Effectively for Scientific Research?" On the same afternoon, a public lecture, complimentary to the citizens of Washington, was given by Prof. I. C. Russell, of the University of Michigan, on "The Volcanoes of the West Indies." On Wednesday evening, the annual dinners of the American Society of Naturalists and the Geological Society of America, and the annual smoker of the American Chemical Society, were held.

On Thursday evening, the secretary of the Smithsonian Institution, Prof. Langley, held a reception in the National Museum.

On Friday afternoon, a lecture, complimentary to the citizens of Washington, was given by John Hays Hammond, on "Rhodesia, the Site of the Mines of King Solomon." Friday evening, the local committee, with the trustees of the Corcoran Art Gallery, gave a reception to the visiting members of the Association and the affiliated societies at the Art Gallery.

On Saturday morning, President Roosevelt received all visiting members at the White House.

Several important changes in the constitution of the Association went into effect at this meeting, all tending toward the improvement of the stability of the council and the sectional committees. Hereafter, the sectional committees will hold office for five years; the secretaries of sections will also hold office for five years, and the council will elect annually three members at large to serve for three years. National scientific societies adopting permanent affiliation with the Association are now represented upon the council of the Association, and this body probably at the present time includes a larger number of the active leading scientific men of America than any other organisation, not excepting the National Academy of Sciences.

Many notable papers were presented during the session, and the character of the proceedings, as will appear from the published reports in the journal *Science*, the organ of the Association, will undoubtedly show a very general improvement over the papers of previous meetings.

The general committee decided upon St. Louis as the next place of meeting, the time to be during Convocation Week of 1903–4, and recommended to the next general committee that Philadelphia be the following place of meeting during the Convocation Week of 1904–5.

The officers elected for the St. Louis meeting are as follows:—

President, Carroll D. Wright, Washington.

Vice-presidents:—Section A, Mathematics and Astronomy, O. H. Tittmann, Washington; B, Physics, E. H. Hall, Harvard University; C, Chemistry, W. D. Bancroft, Cornell University; D, Mechanical Science and Engineering, C. M. Woodward, Washington University; E, Geology and Geography, I. C. Russell, University of Michigan; F, Zoology, E. L. Mark, Harvard University; G, Botany, T. H. Macbride, University of Iowa; H, Anthropology, M. H. Saville, American Museum of Natural History; I, Social and Economic Science, S. E. Baldwin, New Haven; K, Physiology and Experimental Medicine, H. P. Bowditch, Harvard University.

General Secretary, C. H. Wardell Stiles, U.S. Revenue Marine Hospital and Public Health Service.

Secretary of the Council, Charles S. Howe, Case School.

Secretaries of the Sections:—Section A, Mathematics and Astronomy, L. G. Weld, University of Iowa; B, Physics, D. C. Miller, Case School; C, Chemistry, A. H. Gill, Massachusetts Institute of Technology; D, Mechanical Science and Engineering (no election); E, Geology, G. B. Shattuck, Baltimore; F, Zoology, C. Judson Herrick, Denison University; G, Botany, F. E. Lloyd, Teachers' College, Columbia University; H, Anthropology, R. B. Dixon, Harvard University; I, Social and Economic Science, J. F. Crowell, Washington; K, Physiology and Experimental Medicine, F. S. Lee, Columbia University.

The treasurer, Prof. R. S. Woodward, of Columbia University, and the permanent secretary, Dr. L. O. Howard, of the U.S. Department of Agriculture, remain unchanged.

BUBONIC PLAGUE AT HOME AND ABROAD.

A VOLUME of reports and papers on bubonic plague has recently been issued by the Local Government Board,[1] in continuation of the series originally commenced by the late Mr. Netten Radcliffe and since carried on by Dr. Bruce Low. In the preceding volume, Dr. Bruce Low carried the history of the distribution of plague throughout the world to the middle of 1898, while the present report comprises the period from the middle of 1898 to the middle of 1901.

Dr. Low follows the occurrence and progress of bubonic plague chronologically and topographically by

[1] "Reports and Papers on Bubonic Plague." By Dr. R. Bruce Low. With an Introduction by the Medical Officer of the Local Government Board. Pp. xi + 446. (London: Eyre and Spottiswoode, 1902.) Price 4*s*. 1*d*.

the aid of a host of official documents, and partly from numerous other publications. To procure, sift, digest and arrange this enormous mass of polyglot literature is a task as complex as it is difficult, and, looking through the present volume, the reader will agree that Dr. Low has done a difficult piece of work in an exhaustive manner. The usefulness of such a work to the sanitarians of the world must be obvious. Dr. Low, in a clear and systematic and at the same time objective manner, describes the progress and general character of plague as it appeared in and as it affected the various countries during the period stated (middle of 1898—middle of 1901); to this are added the official regulations and procedures in use in the different countries in dealing with plague.

As might be expected, the first place is given to England, Wales and Scotland; there being no case of plague recorded in Ireland, Dr. Low passes on to other European countries in which cases of plague have occurred, and then takes his readers into Turkey, the Levant, Arabia, South and Central Africa, India, the Far East, Australia and New Zealand, and finally America. As to the cases of plague that had been imported into England and Wales, it is satisfactory to learn from Dr. Low's account that the vigilance of, and procedures adopted by, our port sanitary officers were on the whole unremitting and thoroughly efficient; that whenever the case required it, the Local Government Board by its medical inspectors promptly and energetically assisted the port sanitary and local authorities in devising and carrying out the necessary protective and prophylactic measures. As a matter of fact, practically all the cases of plague that reached our shores were promptly intercepted and dealt with, and no further spread of the disease occurred.

Of no mean interest and importance are the facts collected by Dr. Low as to the relation of plague in the rat to plague in the human subject, and we cannot do better than quote here the concise summary on the subject by the Medical Officer of the Local Government Board (p. x).

"The records to which Dr. Low has had access, though they go to confirm belief that as regards plague man and the rat are reciprocally infective, fail completely in affording sufficient data for determining the degree to which man is in danger through the rat. So far as plague ashore is concerned, it would appear that in particular localities man and the rat suffered from plague coincidently; that in other localities man suffered before the rat; and that in others again the rat suffered antecedently to man. Further, it would appear that when in a particular district the one (man or the rat) has suffered plague antecedently to the other, the interval between invasion of the first and of the second species has been often a long one—extending sometimes over weeks and months. Finally, it would appear that plague may prevail largely among men without rats becoming conspicuously affected; and conversely that the disease may cause large mortality among rats of a locality while neglecting to attack its human inhabitants. As regards plague on shipboard, very similar facts were forthcoming. The disease does not, under conditions of sea transit, appear to be at all readily conveyed from the rat to man or from man to the rat. On the one hand, ships plague-invaded for several weeks in the persons of crew or passengers have come into port with the rats on board them seemingly altogether exempt from disease; and on the other hand, ships infected with plague-smitten rats have, after voyages of considerable duration, arrived at their destinations wholly free from plague as regards crew and passengers."

There is, then, no cause for the extreme views which some alarmists have put forward, *i.e.* those who would wish us to prevent any ship coming from an infected country from landing or discharging cargo unless previously all rats on board were destroyed, even in cases where no disease occurred amongst the crew or passengers. Such a procedure would, in the face of Dr. Low's array of facts, be quite unnecessary, and would inflict on shipping in general hardships which experience has shown would be scarcely justified even in the case of ships which on their voyage had actually been infected with plague.

(From the detailed account by Dr. Tidswell of the characters, origin and progress of the plague in Sydney,[1] it appears that the outbreak in man was preceded by great mortality amongst rats from plague, and, further, that the progress of the epidemic amongst human beings in different parts of the town was consistent with the dissemination of the contagion by rats.)

There is one further important point to be noted in the account by Dr. Low, and that is the comparatively simple and comprehensive manner in which plague-stricken or plague-suspected vessels arriving on our shores are dealt with, and the complete success which so far has attended the procedures both as to passengers and crew and cargo. These procedures contrast in a most favourable way with some of the doings in similar circumstances of the authorities in some other countries, in which countries machinery is put in action the chief object of which appears to be the most vexatious treatment of harmless passengers (*vide* s.s. *Niger*, Marseilles, p. 117).

The description of the epidemic of plague in Oporto in 1899 is very instructive reading, and throws into strong relief the broad fact, observed also in Glasgow (1900), in Alexandria, Bombay, the Cape and other places, how difficult, nay, impossible, it is to trace in these epidemics the origin of the outbreaks, the manner and channels in which the contagium had found entrance, and the lapse of considerable and most valuable periods before the disease as such is actually recognised. In these respects, England and Wales have so far been most fortunate in the Local Government Board having everywhere, in our seaports as well as inland, the attention of Medical Officers of Health early, and especially, directed to the danger of importation and to the best means to lessen it and to deal with any case should such occur. It is a fact that, in a good many instances, Medical Officers of Health have with laudable promptitude carefully taken account even of cases which from their clinical and epidemiological characters were not considered as cases of plague, but because they bore in one respect or another a resemblance to plague were notified and subjected to further examination. As was to be expected, these cases were proved not to have been cases of bubonic plague. On the other hand, the necessity for noting all such cases lies in this, that there are atypical cases of real plague which in clinical respects have only a distant resemblance to that disease; such atypical cases of plague could, under less strict supervision, easily escape detection and be the starting point for dissemination of the disease.

A point of extreme interest to western countries is the comparison between the epidemics in the oriental, from which the present pandemic of plague started (1894), and the occidental countries into which it was imported and disseminated. The result of this comparison is highly gratifying, since it shows the very much lesser virulence of the disease in the occidental than in the oriental countries. The Medical Officer thus summarises these important facts (p. viii):—

"There can be no question at all as to plague having very especially affected certain Oriental populations; outside the Asiatic continent, the disease has manifested small ability to become seriously epidemic. For instance, in India, plague, while year after year producing a heavy

[1] "Some Practical Aspects of the Plague at Sydney," by Dr. Frank Tidswell (*Journal* of the Sanitary Institute, vol. xxi. part iv.).

rate of mortality, has at the same time proved exceptionally virulent, as shown by a high ratio of deaths to attacks; and this notwithstanding strenuous efforts on the part of well equipped sanitary bodies to obtain and to maintain control of the disease; whereas in many other countries in various quarters of the world, not a few of them greatly inferior to India as regards administrative preparedness to resist imported disease, plague has failed, when introduced, to cause any but insignificant mortality, has not tended to recur from year to year, and has proved infinitely less virulent case for case than in better ordered India."

A detailed account of the regulations, orders, &c., employed in all the affected countries, with ten carefully arranged coloured maps, form a valuable addition.

E. KLEIN.

THE ARCHIVES OF PHONOGRAPHIC RECORDS.

THE Imperial Academy of Sciences of Vienna has recently appointed a commission to inquire into the possibilities of the application of the phonograph to scientific purposes. It would appear that this instrument has as yet been used mainly as a means of domestic recreation or as an adjunct to the penny showman, but it is quite clear that the instrument provides a means of preserving actual spoken specimens of languages, especially of those which are in a state of gradual development and growth or in a condition of decay. Moreover, by bringing the spoken speech or dialect of distant lands and out-of-the-way districts to those to whom they would be otherwise inaccessible, a most valuable means of scientific research is made available. Recognising the latent possibilities of the phonograph in this direction, the Vienna Academy appointed the above-mentioned commission, the special task of which was the establishment, if possible, of central archives where phonographic records could be kept, duplicated and made accessible to the general scientific world.

The commission has recently issued its second report, dated July 11, 1902, in which the position of affairs at that date is recorded.

The preliminary work undertaken was chiefly mechanical in nature and was concerned in the production of a standard instrument (Archiv-phonograph), and in working out the method of preservation and duplication of the records. It is, of course, self-evident that the wax record is unsuitable for preservation, and in order that this may be most conveniently copied in metal, the Archiv-phonograph has a flat wax plate instead of a cylindrical one. The instrument is shown in Fig. 1. The "cast" wax plate is fixed on the round metal plate (24), which is caused to revolve round its centre by means of the gear shown, the driving force being a wound-up spring contained in the bottom case. The speed of rotation can be adjusted by means of the screw (32) and is indicated by a pointer in (33). The Edison recorder is contained in (7) and is caused to travel radially over the plate (24) so that the record is in the form of a spiral on the same; the distance between each line is $\frac{1}{4}$ mm. It can be seen that the instrument is of very solid construction, and as such would be of more likely use for the laboratory than for purposes requiring its transport from place to place. The wax recommended is that used by Edison, and a plate is capable of taking a speech of two minutes' duration. The metallic negative is prepared as follows. The wax is removed from the instrument and peppered and brushed all over with very fine graphite, the current connection being made by a ring of copper wire stuck into the middle of the plate. Alcohol is then poured over the graphited plate, and it is at once placed in the electrolytic bath and copper deposited thereon. The formed negative is sprung from the wax, cleaned and polished, and flashed over with a very thin layer of nickel in a nickel bath. These metal "phonotypes" are used as patterns for casting the "Archiv" plates in wax which are used in the phonograph for the reproduction of the acoustic record. The metal negatives are, of course, durable and are kept, and as many "Archiv" plates can be cast off them from time to time as may be desired.

In order to put the ideas underlying the appointment of the commission to practical test, three scientific expeditions recently sent out by the Vienna Academy were each provided with an Archiv-phonograph, and the reports furnished by the leaders of these expeditions are given. The expeditions were two philological ones to Kroatia and Slavonia and Lesbos respectively, and a geological one to Brazil. It is evident from the reports that the, it is true, interesting and valuable records obtained were only got by dint of much trouble and perseverance, as the apparatus for such purposes is most unsuitable, the whole outfit weighing, as it does, 120 kilogrammes. Such an apparatus may be compared to a photographic artist's studio camera, while what is required is something more of the nature of a hand camera. It was found impossible to remove the phonograph any distance from the railway, so that very

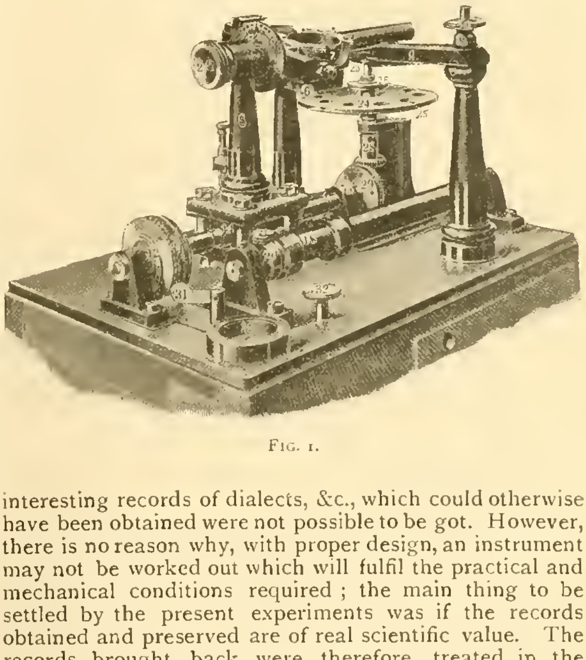


FIG. 1.

interesting records of dialects, &c., which could otherwise have been obtained were not possible to be got. However, there is no reason why, with proper design, an instrument may not be worked out which will fulfil the practical and mechanical conditions required; the main thing to be settled by the present experiments was if the records obtained and preserved are of real scientific value. The records brought back were, therefore, treated in the above-delineated manner, and the "Archiv" plates obtained submitted to the leaders of the expeditions and to other authorities, who reported that they gave, as a rule, a good reproduction of the original speech and words, from which it may be concluded that the method adopted is a success and capable of much use in the future. Of course, certain limitations, such as the differentiation of similar consonants, &c., have to be recognised, and whether the phonograph is capable of such improvement that it will get over these remains to be seen; at any rate, if the establishment of the phonographic archives is a success, it is likely that our descendants one or two thousand years hence will not find themselves in the same predicament as to our present pronunciation as we are as to that of our Latin and Greek, not to mention other dead languages, and that besides this advantage to our posterity, valuable service to science of the present day will result.

C. C. G.

PROF. LADISLAV CELAKOVSKÝ.

AFTER a long and painful illness, due to a serious internal malady of many years' standing, Prof. Čelakovský, the well-known and brilliant botanist, passed away at Prague on November 24, at the age of sixty-seven.

It was with the morphological department of botanical science that Celakovský chiefly identified himself.

His papers dealing with evolutionary problems appear to date from the year 1868 with the memoir "On the General Evolution of the Vegetable Kingdom." The theses "On the Different Forms and the Meaning of the Alternation of Generations in Plants" (1874) and "On the Threefold Alternation of Generations in the Vegetable Kingdom" (1877) appear to us to afford so adequate a solution of this great subject as to cause wonder that botanists should still vex their minds by discussion of it. Two treatises which must long keep his memory green, while helping to establish the supremacy of his genius, are those on "The Law of Reduction in Flowers" (1894) and on "The Evolution of the Flower," in two parts (1896 and 1900); at the latter end of the second part, an interesting discussion and, in our view, a probable solution of the of late much-debated phenomenon of "double-fertilisation" in Angiosperms is introduced. These works of our author are, we fear, far too little known or appreciated.

To many botanists, Čelakovský will be best known by his voluminous writings, published in many and various periodicals, on the morphological nature of the ovule, a subject which occupied his attention from 1874 onwards and which his surpassing talent completely illuminated. Both in this and other difficult cases, he relied almost entirely on teratological evidence for the final solution of the problem. It is this position, well brought out in his memoir in *Lotos* of 1874, "On the Relationship between the Different Methods of Morphological Research," which caused so much opposition to him from fellow-workers in the same fields.

During the latter part of his career, Čelakovský performed the enormous service of what we consider to be the complete unravelling and elucidation of the nature of the female flower in Coniferæ, a subject hitherto utterly obscure and bristling with difficulties, but now, to our mind, entirely solved once for all. The author's views are contained chiefly in "Die Gymnospermen" (1890) and "Nachtrag zu meiner Schrift über die Gymnospermen" (1897).

Another important field of botanical research yielded scope for the display of his great powers, viz., that connected with the building-up of the stem and its members. Three of the principal papers treating of this subject are "On Terminal Members" (1876), "On Cases of Branching Underlying the Phytostatic Law" (*Pringsheim's Jahrbücher*, vol. xxxii.) and "The Segmentation of the Stem" (1901). The latter is an elaboration and wide expansion of the bare principles laid down long ago by Gaudichaud, and revolutionises all modern conceptions of the subject.

Many memoirs have, of necessity, been left unnoticed in this brief sketch; suffice to add that what appears to have been the last paper published by him, at least in German, was that on "The Cortication of the Stem by Leaf-bases," which appeared in 1902.

W. C. W.

NOTES.

WE published last week the wireless telegram sent by President Roosevelt to the King and also His Majesty's reply thereto. This latter message was not sent by wireless telegraphy, the reason being that at the time it was dispatched the nearest telegraph office to Poldhu was closed, and so it was impossible to get the message to Poldhu, though its transmission from there to America could have been easily effected. The *Times* of Monday deals with this difficulty in a leader, and points out that the Post Office as a public institution ought immediately to afford the facilities of connection between Mullion and Poldhu for which the Marconi Company asks. It is only a matter of erecting a couple of miles of telegraph line and providing for a continuous service, and this should certainly be done without any delay. The Post Office is said to be "considering the matter," but in the interests of the public and in fairness to the Marconi Company, the "consideration" ought to be cut short and the necessary connection made at once. As the *Times* rightly says, any questions of the ultimate trustworthiness and utility of the wireless system or of our telegraphic relations with the cable companies or other States have nothing to do with the Post Office, at any rate at the present time. All they are asked to do is to provide facilities for telegraphing to a customer likely to make large use of them. It is sincerely to be hoped that the Post Office will realise that it owes it as a duty to the public to remove immediately this purely artificial hindrance to the development of what may possibly be a great commercial enterprise. Such action would be impossible in any other country.

AN influential committee has been formed in Rome to take measures to honour the memory of Father A. Secchi, S.J., the distinguished astronomer and meteorologist, on the occasion of the twenty-fifth anniversary of his death, which occurred on February 26, 1878. The president of the committee, Father G. Lais, S.J., vice-director of the Vatican Observatory (address, Via Torre Argentina, 76, Rome), will be glad to add the names of scientific men and institutions to the list of those interested in this celebration. Father Secchi was for many years director of the observatory of the Collegio Romano, now occupied by the Italian Central Meteorological Office, and his well-known meteorograph was erected there in 1858. It was in connection with this observatory that almost all Secchi's work was done in solar and terrestrial physics. He published several volumes of the *Memorie dell' Osservatorio del Collegio Romano*, 1852–1863, and began, in the year 1862, the *Bolletino meteorologico*, of which seventeen volumes appeared, and contained many valuable discussions by himself and others. The Italian Spectroscopic Society owes its foundation to his energy. He was the author of numerous papers and also of books on the sun, the stars and the unity of physical forces.

PROF. E. B. POULTON, F.R.S., has been elected president of the Entomological Society for the session 1903–1904. Prof. Poulton has nominated as vice-presidents the Rev. Dr. Fowler, Prof. Meldola, F.R.S., and Dr. D. Sharp, F.R.S.

AT a general meeting of the Linnean Society on January 15, it was resolved to take the necessary steps to obtain a supplementary charter embodying certain alterations in the constitution of the Society. A motion was carried in favour of adding the words "without distinction of sex" to the existing paragraph of the charter referring to the admission of fellows, so that when the supplementary charter has been obtained, women will be eligible for election into the Society.

ON Saturday, January 24, a cone 800 feet in height is reported to have been blown off Mont Pelée by a volcanic eruption.

A TELEGRAM, through Reuter's Agency, received at New York from Kingstown, St. Vincent, states that an eruption of the Soufrière occurred at noon on January 22. A whirling, incandescent cloud was seen to shoot from the volcano clear into the sky, followed by a black cloud, which rapidly ascended to a great height and was visible throughout the island. Sand fell at Château Belair.

THE Central News Agency states that the severest earthquake shock experienced at Charleston since the disaster of 1886 visited this city during the night of January 23. A number of other cities in South Carolina and Georgia were similarly affected.

REFERENCE has already been made to the proposal to form a society of persons interested in electrochemistry. We are glad now to announce that, as the result of the support and encouragement received in response to the circulars recently issued, it has been resolved to hold a general meeting of the supporters of the movement to inaugurate the work of the society and elect a president and council. The meeting will be held at the rooms of the Faraday Club, St. Ermin's Hotel, Westminster, on Wednesday, February 4, at 5 p.m. Dr. J. W. Swan, F.R.S., has consented to be nominated as president, and the following have accepted nomination as vice-presidents:—Prof. A. Crum-Brown, F.R.S., Sir Oliver T. Lodge, F.R.S., Dr. Ludwig Mond, F.R.S., Lord Rayleigh, F.R.S., Mr. Alexander Siemens and Mr. J. Swinburne.

THE twenty-first congress and exhibition of the Sanitary Institute will be held at Bradford, commencing on July 7.

As the work of the Photographic Record Association is attracting much attention, it is of interest to note that at the meeting of the Essex Field Club on Saturday next, Mr. A. E. Briscoe will bring forward a proposal for a photographic and pictorial survey of Essex, to be carried on in connection with the county Museum of Natural History. Anyone wishing to attend should apply to the secretaries, Buckhurst Hill, Essex.

THE Eleventh International Congress of Hygiene and Demography will be held in Brussels on September 2–8 under the patronage of H.M. the King of the Belgians. The secretary-general of the congress is Prof. F. Putzeys. All information and programmes can be obtained from Dr. Paul F. Moline, 42 Walton Street, Chelsea, S.W., the hon. secretary of the British committee.

A REUTER message from St. Petersburg states that two members of Baron Toll's polar expedition, Lieutenant Matissen, commander of the yacht *Zaria*, and Lieutenant Kolchak, have just arrived in St. Petersburg with nine men of the *Zaria's* crew, after an absence of two and a half years.

IT is announced that Dr. Jean Charcot will leave in mid-May for a tour of Arctic exploration in a yacht built in cast steel, and fitted up and manned at his own expense. Dr. Charcot, the *Daily News* Paris correspondent says, is paying great attention to the laboratory fittings and apparatus. His scientific staff will include a zoologist, an expert in oceanography, a bacteriologist, a geologist and a botanist. Provisions for eighteen months will be taken on board, though the expedition is to last but six months.

REFERRING to the recent death of Joseph Chavanne, the Austrian geographer and meteorologist, the *Athenaeum* states that in 1875 he was at work at Vienna in the Imperial Meteorological Institute, and in the same year became editor of the Austrian *Mitteilungen der Geographischen Gesellschaft.* In 1884, he was commissioned by the Brussels Geographical Institute to undertake a topographical survey of the district between the Congo and the Kuilu-Niadi on one side, and between the mouth of the Congo and the Equator station on the other side.

WE learn from *La Nature* that M. H. Poincaré has been promoted to be Commander of the Legion d'Honneur. M. Mascart succeeds M. Berthelot, who has resigned, as the representative of the Collège de France on the Superior Council of Public Instruction. M. Gautier has been elected president of the Bureau des Longitudes; M. Lippmann is the new vice-president and M. Radau the new secretary.

IN addition to the sums which the German Government proposes to allocate for the prevention of typhoid fever and the collection of sickness and mortality statistics, the Imperial budget for the coming year provides, we learn from the *British Medical Journal*, a sum of 3250*l.* for the carrying out of experimental researches directed to the further elucidation of the relation between human tuberculosis and the *Perlsucht* of cattle. The problem of protective inoculation of cattle against tuberculosis falls within the scope of these researches.

ON Thursday next, February 5, at 5 o'clock, Sir Clements Markham will deliver the first of a course of three lectures at the Royal Institution on "Arctic and Antarctic Exploration." Mr. G. R. M. Murray being unable, owing to illness, to deliver his course of lectures beginning on Thursday, February 26, Prof. L. C. Miall will instead deliver three lectures on "Insect Contrivances." The Friday evening discourse on February 6 will be delivered by the Right Hon. Sir Herbert Maxwell, on "George Romney and his Works"; on February 13 by Prof. S. Delépine, on "Health Dangers in Food"; and on February 20 by Principal E. H. Griffiths, on the "Measurement of Energy."

AT a meeting of the Vienna Academy of Sciences on December 11, 1902, Dr. J. Hann presented an important paper on the daily rotation of the mean wind direction and on a semi-diurnal oscillation of the atmosphere on mountain peaks of two to four kilometres above sea level. The author has deduced from anemometrical records the wind components according to the four rectangular directions and has calculated the daily range by means of trigonometrical series. The differences of the hourly values from the daily means obtained in this way exhibit the daily variation both of direction and force, freed from the prevalent wind direction and depending only on the influence of the sun. He has shown in this way that the wind daily rotates regularly with the sun, being easterly in the morning, southerly at noon, westerly and north-westerly in the afternoon and northerly at night. The author has next investigated the daily changes of the wind components and has exhibited their harmonic constituents. The most important result is that in all four components, especially the north and south, a large semi-diurnal period exists, which equals or even exceeds that of the whole-day period in magnitude. The regularity of the phase periods and the magnitude of the semi-diurnal period make it appear probable that this regular daily oscillation of the atmosphere at a height of two to four kilometres is connected with the regular daily oscillation of the barometer. The daily range of mean wind force was also found to follow the same rule on the mountain peaks as on the earth's surface, at all directions attaining its maximum force at nearly the same time, the maximum, however, occurring at nighttime instead of soon after noon.

WE have received vol. vi. of the *Pubblicazioni della Specola Vaticana* (Roma: Tipografia Vaticana, 1902). The first 326 pages are devoted to the meteorological observations made during the years 1895–1901. The observations are printed in full detail, the values for each hour of observation for barometer, aspect of sky, direction and velocity of wind, thermometers, vapour tension, relative humidity, evaporation, &c., being given. Then follow another set of meteorological observations made daily at 9 o'clock during the year 1901. The velocity of the wind and description of the sky are next given for three observations every day during the year 1895. At the end of the volume is given a series of plates, which illustrates graphically the variations of the principal meteorological elements from day to day during each year. More than one hundred pages contain details of the observations of meteors made during the months of

August and November for the years 1896–1901. From a statistical point of view, the volume will prove useful, but it seems a pity that observations should be kept so long before they are published.

THE paper on electric automobiles read by Mr. H. F. Joel before the Institution of Civil Engineers on January 13 is one of great interest. The desirability of the automobile replacing horse traction from a sanitary point of view is probably admitted by everyone, and certainly the electric car would afford the best solution. Mr. Joel is of opinion that there is a great future before the electric automobile, which has already proved itself capable of running 100 miles on one charge and of performing much longer tours. This shows that even the storage battery of to-day is sufficiently good to give very satisfactory results; the author in his paper goes carefully into the results of the battery tests made by the Automobile Club of France, and into the question of the ratio of weight of vehicle to weight of battery. Many valuable curves showing the relations between ton-mileage, total weight, useful load, &c., are given, and the paper is, on the whole, a valuable contribution on the subject.

A SERIES of papers by Dr. Quirino Majorana in the *Atti dei Lincei* of last summer are devoted to the phenomena of magnetic double refraction and the so-called "bimagnetic rotation" of the plane of polarisation. The phenomena were observed by fixing a column of liquid 7 cm. long between the poles of a Weiss electromagnet, the solutions best suited for the purpose being chloride of iron and still better "dialysed iron." The bi-refraction is proportional to the thickness of the liquid column, which is normal to the lines of force and also to the degree of concentration of the solution. For different colours, it varies inversely as the square of the wave-length. Experiments conducted with the view of ascertaining the rapidity with which the phenomena are produced tend to show that, like rotatory polarisation and Kerr's phenomenon, it takes place instantaneously. Dr. Majorana's phenomenon of "bimagnetic rotation," which has already been noticed in these columns, is discussed in conjunction with Voigt's highly probable explanation that it owes its origin to the unequal absorption of the light-components polarised along and perpendicular to the lines of force. It is obvious that in a ray polarised on entrance in a direction making an angle of, say, 45° with the lines of force, the effect of such an unequal absorption would be to deflect the plane of polarisation towards the direction in which the absorption is least. The phenomenon is observed in certain impure solutions of ferric chloride; it is approximately proportional to the thickness of the liquid traversed, at any rate when the deviation is small. As the intensity of the field increases, the deviation at first increases rapidly and then tends to a constant limit. From theoretical grounds, it follows that if the planes of polarisation on incidence and emergence make angles α and β with the lines of force, the ratio of tan α to tan β is constant, and hence $\sin(\alpha-\beta)$ is proportional to $\sin(\alpha+\beta)$, so that the deviation $(\alpha-\beta)$, being small, is proportional to $\sin(\alpha+\beta)$, and hence is a maximum when the angles are nearly 45°, agreeing with the results of experiment.

THE U.S. Department of Agriculture has issued two reports, one by Dr. W. O. Atwater and Dr. F. G. Benedict, on the metabolism of matter and energy in the human body, and the other by Prof. Charles E. Wait, drawn up under the immediate supervision of Prof. Atwater, dealing with the effect of muscular work on the metabolism of nitrogen and the digestibility of food. These reports form a part of the nutrition investigations for which a special committee has been appointed by the Department. The first report deals with thirteen experiments, forming part of a series which are in progress at Middletown, Conn., and which have for their ultimate object the study of the laws of nutrition. The Atwater-Rosa respiration calorimeter used in the experiments is shown to be a satisfactory instrument of precision, and the conclusions, besides affording information as to the demands of the body for nutriment, and the effect of muscular work on digestion and metabolism, afford evidence little short of definite demonstration that the principle of conservation of energy holds good in living organisms.

THE first part of an illustrated paper, by Dr. H. von Buttel-Reepen, on the phylogenetic relationship of bees' nests, and the biology of solitary and social bees, appears in the *Biologisches Centralblatt* for January.

WE have received a copy of the *Transactions* of the Yorkshire Naturalists' Union for 1900, containing reports on the Lepidoptera and also on the botany and meteorology of the county.

IN part i. of the third volume of *Annals* of the South African Museum, Dr. W. F. Purcell describes new genera and species of the arachnoid family Solpugidæ and also certain typical Arachnida.

THE *Zoologist* for January contains an account, by Mr. W. F. Raunsley, of a South American quaker-parrot (*Myiopsittacus monachus*)—said to be the only nest-building species of its tribe—building in the open in the New Forest, near Lyndhurst. The nest, which was of large size, was constructed in the angle of the roof of a house. It is not the first time that birds of this species have nested in the open.

WE have received two fasciculi o. the *Proceedings* or the U.S. Museum (Nos. 1311 and 1312). In the former, Mr. J. E. Benedict describes as new one genus and forty-six species of the crustacean family Galatheidæ, with a list of all the known marine representatives of the group. In the latter, Mr. W. H. Dall gives a synopsis of the molluscan family Veneridæ, with a list of the existing North American species, among which many are new.

THE *Fishing Gazette* or January 17 relates a curious incident which occurred at the fish-breeding establishment at Helmsbach, Germany, on July 3, 1899. In one of the buildings were some tanks containing a number of live trout about to be dispatched to Berlin. During a thunderstorm, a heavy flash of lightning appeared to strike the building, and on examination it was found that all the fish in the tank next an open window were dead. Although the wire-netting covering the tank was not damaged and the fish themselves showed no special signs of having been struck, there seems every probability that the deaths of the latter were caused by the lightning. A similar experience was recorded in Germany in 1901, and some years ago, after a severe thunderstorm, a number of large trout were found dead in a pool in our own Lea.

THE *Quarterly Review* for January contains three articles connected with biological science. In the first, Mr. Lydekker discusses the origin of the present and past vertebrate faunas of South America, devoting special attention to the fossil mammals and birds of the pampean formation of the Argentine and the Santa Cruz beds of Patagonia. It is shown that at the epoch of the deposition of the latter, South America was insulated and inhabited mainly by a fauna of edentates, peculiar ungulates, rodents, monkeys, marsupials and giant birds. A subsequent connection with North America permitted the immigration of northern types, while, conversely, a certain number of southern forms effected an entrance into North America. As to the origin of the primitive South American fauna, there is still much uncertainty and speculation, but it is considered probable that a contingent was furnished from Africa by means of a land-bridge. Some remarkable evidence is cited in regard to the

possible survival of one of the ground-sloths to modern times. The article is illustrated by figures of the remains of some of the extinct forms.

IN the second article—"A Conspectus of Science"—Sir Michael Foster tells the history of the founding of the "International Catalogue of Scientific Literature," three parts of the first volume of which had been issued at the date of going to press. The immense value of the Royal Society's "Catalogue of Scientific Papers" is fully acknowledged; but the absence of a "subject-index" and the omission of all literature other than periodical render this publication—even if it could be continued—inadequate to present requirements. Finally, a brief reference is made to the portions of the "International Catalogue" for 1901 already published, and the hope is expressed that when the staff has got into full swing, the annual volumes will be produced in a shorter space of time.

THE third article in the January number of the *Quarterly* contains a review of a dozen works, for the most part on sport and travel, but including President Roosevelt's volume on deer in the "American Sportsman's Library." The latter work, together with Mr. J. G. Millais's volume on wild-fowl shooting in Scotland, has been already noticed in NATURE. The list also includes Prince Demidoff's two volumes on big-game shooting in the Caucasus and the Altai and Mongolia, Mr. Powell-Cotton's account of his recent Abyssinian expedition and Mr. W. P. Church's "Chinese Turkestan with Caravan and Rifle." The reviewer directs special attention to three features connected with modern sport—the comparative ease with which regions long thought practically inaccessible can be reached, the destruction of game all over the world and the means which should be taken for its preservation, and the advantage of rifles firing small projectiles at great velocity over weapons of larger calibre.

THE evolution of the northern part of the lowlands of south-eastern Missouri, by Prof. C. F. Marbut ("University of Missouri Studies," vol. i. No. 3, 1902), forms the subject of an essay on river development. The author endeavours to show how the Mississippi has abandoned two valleys and now occupies a third. It has, in his opinion, been twice captured by the smaller Ohio river.

REFERRING to our report of Prof. J. B. Farmer's remarks at the Chelsea conference (NATURE, January 15, p. 260), in which mention is made of the conditions under which larch grows, Mr. Hawie Brown gives some particulars of his own experience in the cultivation of this kind of tree. He says, "the best and healthiest and oldest Scottish larch grows on hill-slopes facing the north, where there is not a great depth of soil, but often a thin soil resting on a shaly bed." Prof. Farmer has kindly supplemented our brief reference to his instance of the frequent lack of conscious and common-sense appreciation of the relations existing between cause and effect in the cultivation of crops which has led to the planting of a tree like larch in localities and under conditions obviously unsuitable for it. He adds, "of course the larch is a mountain tree, and the whole point of the illustration lies in the fact that in this particular instance the shallow soil overlying the rock was of a 'sour' and poor character, as indicated by the indigenous weed vegetation. It is generally accepted that the larch is a tree making considerable demands on the soil, both as regards fertility and depth—or, at least, of openness."

OBSERVATIONS on fluctuations in the level and in the alkaline character of the ground water have been made by Mr. W. P. Headden at the Agricultural Experiment Station, Fort Collins, Colorado (*Bulletin* 72, Agricultural College of Colorado, August, 1902). The total salts held in solution in the well waters were less than in the water in the soil. As the water-plane falls, it leaves much saline matter in the soil, but the total solids in the ground water varied greatly in the different wells and also from time to time in each well. Reference is made to the salts that occur at different depths in the soil, to the abundant formation of nitric acid in the upper layers and to the effects of irrigation.

AN ecological memoir possessing more than ordinary merit is the report on a botanical survey of the Dismal Swamp region, compiled by Mr. T. H. Kearney and published by the U.S. Department of Agriculture. The interest lies, not only in the nature of the associated formations, but is also due to the descriptions accompanied by very admirable and well-chosen illustrations. The region surveyed lies between Chesapeake Bay and Albemarle Sound, and is marked by a series of inlets extending into or towards the inundated swamp area. A peculiar feature of these marshy inlets is the Baccharis-Hibiscus formation on the inner edge. Here *Baccharis halimifolia* is conspicuous with a snow-white pappus, and colour is added by *Hibiscus moscheutos* and *Kosteletzkya virginica*, another malvaceous plant. From the coast, a series of dunes leads up to

FIG. 1.—Incursion of the sand on inland vegetation near Cape Henry, Virginia.

the forest. A remarkable plant found on the outer dunes is the aromatic composite *Iva imbricata*. The dunes are encroaching upon the inland vegetation, though not so rapidly as might be expected. Where the dunes are exposed, there the sand is piled up in hillocks, higher even than the neighbouring forest. The illustration which is reproduced shows how the banked-up sand, with a steep inner slope which may approach an angle of 45°, is pouring down on the trees growing in the swampy ground, the desert as it is called, while on the slope some old cypress trees still bearing a few leaves are gradually being overwhelmed in the drift. On the western side is situated Lake Drummond, a small patch in the extensive swamp, where the water has varied from 6 to 15 feet. A weird appearance more especially near the shore is presented by the stumps of old cypress trees, and still more fantastic are the aërating processes, the knees of the bald cypress, *Taxodium distichum*, and the arching roots of the same plant and of the black gum *Nyssa biflora*.

THE *Proceedings* of the Liverpool Geological Society for the session 1901–1902 (vol. ix. part ii., 1902) contain an interesting

address, by Mr. Charles C. Moore, on the volume composition of rocks. He deals with the porosity of various rocks and observes that in many cases the appearance of the specimen does not give the slightest clue to its actual porosity. Comparisons are made between various rocks of similar chemical or mineralogical composition. The effect of pressure in the faulting of a sandstone has been used to calculate the amount of displacement. The structural changes that would occur from the conversion of a bed of limonite into hæmatite are pointed out. The subject is one of considerable practical importance. Among other papers is one by Prof Bonney, on fragmental rocks as records of the past.

MR. HUGH J. L. BEADNELL has given an account of the Cretaceous region of Abu Roash, near the pyramids of Giza (Geological Survey Department, Egypt, 1902). The area lies near the edge of the Libyan Desert, some distance west of Cairo, and it is composed of an isolated massif of Cretaceous rocks in the midst of an unconformable and overlapping tract of Eocene strata. These structural relations have not hitherto been determined. Owing to the highly disturbed nature of the beds, due, as the author explains, to pre-Eocene folding and faulting, it has been a difficult matter to work out the complete succession in the Cretaceous rocks; but this has now been done, and Cenomanian, Turonian, Senonian and Danian subdivisions have been determined. Particulars of these and their fossils are given, together with illustrative sections and excellent photographic views of scenery, and there are brief descriptions of the Eocene and newer deposits. The author observes that the effects of the action of wind-borne sand in the denudation of rocks are perhaps more beautifully displayed at Abu Roash than in most other localities in the western desert—a fact due in great measure to the abundance of hard cherty and crystalline limestones, which so well exhibit the effects. Illustrations of these are given.

A THIRD edition of "Modern Microscopy," by Mr. M. I. Cross and Mr. Martin J. Cole, has been published by Messrs. Baillière, Tindall and Cox. The book has been completely revised, and now contains, in addition to the two parts into which the last edition was divided, a third section on the choice and use of microtomes, prepared by Mr. G. West.

MESSRS. WATTS AND CO. have issued, for the Rationalist Press Association, Ltd., a sixpenny edition, in paper covers, of Mr. Herbert Spencer's "Education: Intellectual, Moral and Physical." These essays are all well known to teachers throughout the world, and it is to be hoped that this cheap reissue will serve to encourage parents everywhere to become familiar with sound principles of education.

THE "Handbook of the Federated Malay States" (Stanford, 2*s.* 6*d.*), compiled by Mr. H. Conway Belfield, British Resident of Selangor, contains trustworthy information brought together at the request of the Government for the use of persons interested in the Malay States. Direct guidance is offered to different classes who propose to emigrate to this part of the world. The handbook is well illustrated and plentifully supplied with maps and statistics.

A COPY of the thirty-third of the thirty-six parts of "Living London," being issued by Messrs. Cassell and Co., Ltd., under the editorship of Mr. G. R. Sims, has been received. It contains a section, by Mr. John Munro, on scientific London, profusely illustrated by pictures showing audiences at the Royal Institution, the Royal Geographical Society and the Society of Arts. A full-page illustration depicts the ladies' night at the Royal Society.

AN almanac for 1903, compiled at the offices of the Survey Department of the Public Works Ministry and published at Cairo, has been received. Much of the miscellaneous information contained in the almanac will be of use to persons in this country personally interested in Egyptian affairs, for example, the conversion tables giving the Egyptian equivalents of English and French money, measures of length and weight. The facts provided deal with every department of administrative activity in the country.

THE eighteenth issue of "Hazell's Annual," that for 1903, has reached us. It is well described by its subtitle as a cyclopædic record of men and topics of the day. Its abundance of information is arranged alphabetically and includes, amongst other matters of interest to men of science, summaries of the work accomplished during 1902 in the chief branches of natural knowledge. Particulars are also given concerning the important scientific societies and of the scientific institutions of a national character, such as the Royal Observatory, the National Physical Laboratory and Kew Observatory.

PROF. LLOYD MORGAN, F.R.S., contributes to the current number of the *International Quarterly* an article on the beginnings of mind. He discusses in the first place the questions, Is mind a product of evolution? second, Is mind a factor in the evolutionary process, and if so, under what limiting conditions? Towards the conclusion of his essay, Prof. Morgan says:—"From the physiological point of view, the conditions of the beginnings of mind would seem to be the differentiation of a control system with conscious concomitants. From the standpoint of behaviour, conscious accommodation through control as the result of individual experience. And what from the psychological point of view? . . . One may surmise that there is, in some dim form of expectation, at least the germ of that looking before and after to which consciousness eventually attains with more and more clearness." Another article in the same magazine deals with ethnology and the science of religion, and Prof. C. Lombroso endeavours to explain why criminals of genius have no type.

THE additions to the Zoological Society's Gardens during the past week include an American Grass Snake (*Contia vernalis*) from Mexico, presented by Miss Green; two Smooth-headed Capuchins (*Cebus monachus*) from South-east Brazil, two Derbian Wallabys (*Macropus derbianus*), three Brush Turkeys (*Talegalla lathami*) from Australia, a Blue-fronted Amazon (*Chrysotis aestiva*), a Common Boa (*Boa constrictor*) from South America, deposited; nine Regent Birds (*Sericulus melinus*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 2. 7h. 11m. Minimum of Algol (β Persei).
6. 9h. 45m. to 10h. 30m. Moon occults δ^2 Tauri (mag. 4·7).
9. 3h. 56m. to 4h. 49m. Moon occults λ Geminorum (mag. 3·6).
9. 11h. 21m. to 12h. 25m. Moon occults 68 Geminorum (mag. 5·0).
11. 16h. 47m. to 17h. 45m. Moon occults υ Leonis (mag. 4·5).
11. Ceres in opposition to the sun (Ceres mag. 7·4).
14. Venus. Illuminated portion of disc = 0·951, of Mars = 0·942.
15. 11h. 0m. Mars in conjunction with Moon (Mars 3° 22′ N.).
19. 4h. 0m. Jupiter in conjunction with the sun.
19. 12h. 5m. Minimum of Algol (β Persei).
22. 8h. 54m. Minimum of Algol (β Persei).
22. Perrine's comet (1902 *b*) 2½° E. of Sirius.
25. 5h. 43m. Minimum of Algol (β Persei).
27. 11h. 0m. Mercury at greatest elongation (26° 58′ W.).
27. Perrine's comet (1902 *b*) 3½° N. of Sirius.
28. Giacobini's comet (1902 *d*) 2½° S.S.W. of ϵ Geminorum (mag. 3·2).

COMET 1902 *d* (GIACOBINI).—A daily ephemeris of this comet is given by M. G. Fayet in No. 3840 of the *Astronomische Nachrichten*. The following is an extract therefrom :—

12h. M.T. Paris.

Date.	α h. m. s.	δ ° ′	log *r*.	log Δ.	Brightness.
Jan. 29 ..	6 43 16	+12 53·2	0·4524	0·2871	1·48
Feb. 2 ..	6 41 15	+14 12·7	0·4513	0·2911	1·46
,, 6 ...	6 39 33	+15 31·2	0·4502	0·2961	1·43
,, 10 ..	6 38 13	+16 48·3	0·4493	0·3019	1·40
,, 14 .	6 37 17	+18 3·5	0·4484	0·3085	1·36
,, 18 ...	6 36 45	+19 16·4	0·4476	0·3158	1·32
,, 22 ..	6 36 38	+20 26·7	0·4469	0·3237	1·28
,, 26 ...	6 36 58	+21 34·3	0·4463	0·3321	1·24
Mar. 2 ...	6 37 44	+22 39·0	0·4458	0·3408	1·19

Brightness at time of discovery = 1·0.

COMET 1903 *a* (GIACOBINI).—The following ephemeris has been calculated by Herr M. Ebell and Prof. H. Kreutz (*Kiel Circular*, No. 57).

Ephemeris for 12*h. M.T. Berlin.*

Date.	α. h m. s.	δ ° ′	log. Δ	Brightness
Jan. 31 ...	23 11 57 ...	+5 24·9 ...	0·2043 ..	1·9
Feb. 4 ...	23 17 25 ...	+6 35·6 ...	0·1909 ...	2·4
8 ...	23 23 17 ...	+7 51·3 ...	0·1753 ...	3·0
12 ...	23 29 35 ...	+9 13·1 ...	0·1573 ...	3·8

Brightness at time of discovery = 1·0.

SEARCH-EPHEMERIS FOR THE COMET TEMPEL$_3$-SWIFT.—In No. 3840 of the *Astronomische Nachrichten*, M. J. Bossert gives a daily ephemeris for the search of this comet from which the following is an abstract :—

12h. M.T. Paris.

Date	α h. m. s.	δ ° ′	log *r*	log Δ
Jan. 29 ...	0 8 43 ...	+ 5 17·4 ...	0·062	0·141
Feb. 1 ...	0 20 24 ...	+ 6 25·4		
3 ...	0 28 15 ...	+ 7 10·5 ...	0·064	0·142
6 ...	0 40 9 ...	+ 8 17·7		
8 ...	0 48 9 ...	+ 9 2·0 ...	0·067	0·144
11 ..	1 0 14 ...	+10 7·6		
13 ...	1 8 21 ...	+10 50·7 ...	0·072	0·148

A BRIGHT METEOR.—Mr. C. J. Lacy, writing to the *Times* from Fleet, Hants, says that on January 25, at 7.57 p.m., he observed a very bright meteor. "It first attracted my attention near the zenith, and must have come within our range a few degrees to the south of Capella, which star, being directly in its path, was possibly even occulted. It sailed slowly and majestically in a N.N.W. direction, passing about two degrees north of Cassiopea and finally disappearing near the star Alderámin in Cepheus." The head was remarkably brilliant and the tail was about ten or eleven degrees in length.

THE PLANET MARS.—In the January *Bulletin de la Société astronomique de France*, M. E. Touchet gives some details respecting the coming opposition of Mars, and directs special attention to the fact that between February 27 and August 20 of this year, observers will have the opportunity of observing the phenomena attending the Martian summer in the northern hemisphere. The disappearance of the snow-cap will be the main feature, and is easily seen with small instruments.

Two excellent coloured drawings of this planet, as observed with the 9½-inch equatorial at Juvisy by MM. Flammarion and Antoniadi during the last opposition, accompany the article.

REPORT OF THE HARVARD COLLEGE OBSERVATORY.—The fifty-seventh annual report of this observatory deals with the work done during the year which ended on September 30, 1902.

A recent anonymous gift of twenty thousand dollars has enabled the authorities to erect a new fireproof wing in which to store the immense library of negatives which they now possess, and also to contract with Messrs. Alvan Clark and Sons for a new 2-foot reflector, which will be used, first at Cambridge (Mass.) and then at Arequipa, for obtaining photographs of faint objects in all parts of the sky.

Seventeen thousand photometric light comparisons, observed with the East equatorial, 66,932 settings of the 12-inch meridian photometer and 10,784 measures with the smaller meridian photometer have been made during the year by Profs. Wendell, E. C. Pickering and Bailey respectively.

The "Henry Draper Memorial" photographs now show the spectrum of every star in the sky which is permanently greater than the ninth or tenth magnitude, besides many more which are fainter.

Prof. Bailey has been to Arequipa, taking the meridian photometer with him, in order to obtain measures of comparison stars for the observation of Eros at its next opposition, when it will be too far south for the European and United States observatories to observe it.

The Blue Hill Meteorological Observatory, carried on at the expense and under the direction of Mr. Rotch, has made several special series of observations during 1902, amongst which the determination of the meteorological conditions of the upper atmosphere by means of kites has been very successful. It is now proposed to explore the atmosphere above the tropics and the equator by this means.

The time service is now working under a new system, devised by Mr. Gerrish, in which an electric light, which acts as the signal, is made to pulsate in response to the signals from the standard clock.

A RECORD OF THE TOTAL SOLAR ECLIPSE OF 1898.

THIS interesting report[1] has been considerably delayed for the reason given in the preface that the director, Prof. Naegamvala, has been engaged in securing solar and stellar spectra which might assist in discussing the chromosphere spectrum, which he considers was first adequately secured at this eclipse.

The report gives the usual details as to the selection of a site, ultimately fixed at Jeur, and gives a full description of the instruments used and of the work of the observers. It is liberally furnished with maps and photographs, and we must express our admiration of the excellent manner in which these records have been reproduced.

The report itself is interesting reading and appeals to a larger audience than professional astronomers; any intelligent reader casually taking it up will find much to attract his attention.

The pictures of the corona are particularly fine; maps showing the alterations in its shape at maximum and minimum sun-spot periods, compiled from various sources, are appended and may be useful for handy reference.

The spectrum of the lower chromosphere appears to have been the part of the subject which had the most attraction for Prof. Naegamvala, and he has devoted a large part of the report to this question. Some authorities regard it as a mere reversal of the Fraunhofer spectrum, while others, Sir Norman Lockyer in particular, consider that the reversals take place, not in one thin layer, but at various levels of the solar atmosphere. So far as this point is concerned, Prof. Naegamvala comes to the conclusion that there "can be no question that Lockyer has fully established his contention." With regard to the true explanation of the chromospheric lines in relation to the Fraunhofer spectrum generally, he considers the question to be still *sub judice*. The very important point of the intensities of the lines of the chromospheric spectrum as compared with those of the Fraunhofer spectrum has, however, not been included in the discussion.

It is unfortunate that, as Prof. Naegamvala states, the six-inch prismatic camera with which the so-called "flash" spectrum was taken was somewhat out of focus, owing to the brief time at the observer's disposal for its adjustment, and from the reproduction of the plate the arcs are apparently not sufficiently sharp for accurate measurement. For this purpose, they are distinctly inferior to the spectrum obtained by Mr. Shackleton at Novaya Zemlya in 1896, which, from a remark in the preface, Prof. Naegamvala thinks he has improved on. On this point, we are afraid we cannot agree with him.

The wave-length of the celebrated "green line" is found by the Poona measurements to be λ 5301·195, which is rather less than that found by other observers.

Although we do not think that the many questions connected with eclipses are advanced beyond the point reached by other observers and whose reports were published long ago, we can heartily congratulate Prof. Naegamvala and his eclipse observers on having produced so interesting and readable a volume.

H. P.

[1] Report on the total solar eclipse of January, 1898, by Kavaoji Dadabbai Naegamvala, director of the Observatory at Poona. (Bombay: Government Central Press.)

CHARACTERISTICS OF RECENT VOLCANIC ERUPTIONS.[1]

THERE is a remarkable similarity between the islands of St. Vincent and Martinique. Both are roughly oval in form, with the long axis almost north and south. The north-west portion of each is occupied by a volcano, the Soufrière and Mont Pelée, which have many points in common. Both volcanoes show a single or practically single vent, and a remarkable absence of parasitic cones and a scarcity of dykes. In both a transverse valley exists to the south of the volcanoes, and the main discharge of ejecta during the recent eruptions, which have often been nearly synchronous, has been into this depression, and especially into its westerly portion. In both islands, the recent eruptions have been characterised by paroxysmal discharges of incandescent ashes, with comparatively few larger fragments and a complete absence of lava.

There are, however, a few points of difference. The eruptions of St. Vincent have been altogether on a much larger scale than those in Martinique. The area devastated was considerably larger, the amount of ashes ejected probably ten times as great, and if the loss of life was not so large, this is accounted for by the absence of a populous city at the foot of the mountain. While both volcanoes show practically a single vent, this is much more marked by the case of St. Vincent, where, excepting the new crater, which is practically part of the old or main one, there is not a single parasitic cone. We saw no fumaroles, no hot springs, or any trace of radial cracks and fissures.

On Mont Pelée, it is true, the main activity is confined to a restricted area about the summit of the mountain, and the top of the great fissure which extends or extended from this down in the direction of the Riviere Blanche; and there are no parasitic cones comparable, for instance, to those which are so numerous on Etna; but there are many fumaroles, which Prof. Lacroix and his colleagues speak of as emitting gases hot enough to melt lead and even copper wire. A telegraph cable has been three times broken at about the same place, and the broken ends on one occasion, at any rate, showed marks of fusion. There are also several hot springs. Judging from these and other indications, it is most probable that radial cracks entered deeply through the substance of the mountain, and penetrated even the submarine portion of its cone.

The local distribution of erupted material in Martinique is accounted for by the great fissure at the top of the valley of the Riviere Blanche, which communicated with the main pipe of the volcano, and out of which the eruptions took place. This fissure, which was mentioned as existing in the eruption of 1851, pointed almost directly towards St. Pierre, and as the erupted material flowed out almost like a fluid, it was directed straight down on the doomed city. The lowest portion of the lip of the crater of the Soufrière was much broader and more even, so the incandescent avalanche which descended from it was spread much more widely.

The latest accounts from Prof. Lacroix indicate that the recent small eruption of Mont Pelée has filled up the highest parts of the fissure and formed a cone, the foot of which covers up the former crater ring. In any further eruption, therefore, the avalanche of incandescent sand will not be confined to the district of the Riviere Blanche, but may descend on any side of the mountain.

The accompanying photograph of Mont Pelée in eruption was obtained from a ten-ton sloop in a sea way and is therefore not quite sharp. Attention was directed to the eruption by a peculiar black cloud which appeared over the volcano and then rolled down the side of the mountain to the sea. The cloud was formed of surging, rolling, expanding masses, in shape much like those of the previous cauliflowers, but quite black, and full of lightning-flashes and scintillations, while small flashes constantly struck from its lower surface on to the sea. The upper slopes of the mountain cleared somewhat, and some big red-hot stones were thrown out; then the triangular crack became red, and out of it poured a surging mass of incandescent material, reminding us of nothing so much as a big snow-avalanche in the Alps, but at a vastly different temperature. It was perfectly well defined, did not at all tend to rise like the previous cauliflowers, but flowed rapidly down the valley in the side of the mountain which had clearly been the track of previous eruptions, until in certainly less than two minutes it reached the sea, and was there lost to view behind the remains of the first black cloud, with which it appeared to coalesce. There and on the slopes of the mountain were doubtless deposited the greater part of the incandescent ash, while the steam and gases, with a certain portion of still entangled stones and ash, came forward in our direction as a black cloud, but with much greater rapidity than before. The cloud got nearer and nearer; it was well defined, black and opaque, formed of surging masses of the cauliflower type, each lobe rolling forward, but not all with one uniform rotation; bright scintillations appeared, some in the cloud itself and some like little flashes of light vertically between the cloud and the sea on which it rested. This was clearly the phenomena described by the survivors in the St. Vincent eruption as "fire on the sea," occurring in the black cloud which overwhelmed the windward side of that island. We examined them carefully, and are quite clear that they were electric discharges. The scintillations in the body of the cloud became less numerous and more defined, and gradually took the form of vivid flashes of forked lightning darting from one part of the cloud to another. When the cloud had got within perhaps half a mile or a mile of us—for it is difficult to estimate distances at sea and in a bad light—we could see small material falling out of it in sheets and festoons into the sea, while the onward motion seemed to be chiefly confined to the upper part, which then came over our heads and spread out in advance and around us, but left a layer of clear air in our immediate neighbourhood. It was ablaze all the time with electric discharges.

FIG. 1.—Photograph of an eruption of Mont Pelée.

As soon as it got overhead, stones began to fall on deck, some as big as a walnut, and we were relieved to find that they had parted with their heat and were quite cold. Then came small ashes and some little rain. The cloud was also noticed at Fort de France. It was described as like those in the previous eruptions, but was the only one in which electric scintillations had been noticed. Two unbiased observers, who had seen it and that of May, declared this was the larger of the two.

As to the mechanism of the hot blast and the source of the power which propelled it, both Dr. Flett and I are convinced of the inadequacy of previous explanations, such as electricity, vortices, or explosions in passages pointing laterally and downwards, or explosions confined and directed down by the weight of the air above. Such passages into the mountain, which, to be effective, would require to be closed above, do not exist in the case of the Soufrière, and we are not aware that they have been observed in Mont Pelée; and as to the weight of the air, this did not prevent the explosions in the pipe of the Soufrière from projecting sand and ashes right through the whole thickness of the trade-winds until they were caught by the anti-trade current above and carried to Barbados. Moreover, the black cloud, as we saw it emerge from Mont Pelée, seemed to balance itself at the top of the mountain, start slowly to descend and gather speed in its course, and the second incandescent dis-

[1] From a discourse delivered by Dr. Tempest Anderson at the Royal Institution on January 23.

charge followed the same rule. We believe that the motive power for the descent was gravity, as in the case of any ordinary avalanche.

The accepted mechanism of a volcanic eruption is that a molten magma rises in the volcano chimney. It consists of fusible silicates and other more or less refractory minerals, sometimes already partly crystallised, and the whole highly charged with water and gases, which are kept in a liquid state by the immense pressure to which they are subjected. When the mass rises nearer the surface and the pressure is diminished, the water and gases expand into vapour and blow a certain portion of the heavier and less fusible materials to powder, or, short of this, form pumice stone, which is really solidified froth, and they are violently discharged from the crater. When the greater part of the steam and gases have been discharged, the lava, still rising, gets vent either over the lip of the crater or often through a lateral fissure, and flows quietly down the side of the mountain.

It is quite recognised that these phenomena may occur in various relative proportions. We believe that in these Pelean eruptions, the lava which rises in the chimney is charged with steam and gases, which explode as usual, but some of the explosions happen to have only just sufficient force to blow the mass to atoms and lift the greater part of it over the lip of the crater without distributing the whole widely in the air. The mixture of solid particles and incandescent gas behaves like a heavy liquid, and before the solid particles have time to subside, the whole rolls down the side of the mountain under the influence of gravity, and consequently gathers speed and momentum as it goes. The heavy solid particles are gradually deposited, and the remaining steam and gases, thus relieved of their burden, are free to ascend.

The effect of avalanches in compressing the air before them and setting up a powerful blast, the effects of which extend beyond the area covered by the fallen material, has long been recognised. A group of large trees was overthrown by the blast of the great avalanche from the Attels on the Gemmi pass in 1895; all lay prostrate in directions radiating away from the place where the avalanche came down.

THE ZOOLOGICAL SOCIETY'S MEETING.

THE monthly meeting of the Zoological Society of London, at their house in Hanover Square, held on January 22, was well attended, it being expected that some account of the operations of the committee of reorganisation recently appointed by the council, on the occasion of the change in the secretaryship, would be given. The chair was taken by His Grace the Duke of Bedford, K.G., the president, at 4 p.m., and the new secretary, Mr. W. L. Sclater (lately director of the South African Museum, Cape Town), was present for the first time. After the election of new fellows and other routine business, the report of the council was read by the secretary. It stated that thirty additions had been made to the Society's menagerie during the month of December last, amongst which was a very fine pair of the one-wattled cassowary (*Casuarius uniappendiculatus*), deposited by the Hon. Walter Rothschild, M.P. The report also stated that the total income of the Society in 1902 had been 29,077*l.*, being, in spite of the bad weather that had prevailed during the summer, only 273*l.* less than the receipts of the previous year, and being the sixth largest annual income ever received by the Society. The report of the reorganisation committee was then read to the meeting by Sir Harry Johnston, K.C.B., the hon. secretary of the committee. It was divided into numerous heads relating to every branch of the Society's affairs, and containing recommendations thereon. Many of these were of a technical character, but important changes were advised under the heads of the gardens and menagerie, the prosectorium, the staff at Hanover Square and the secretaryship. The charge of the Society's gardens and menagerie was proposed to be entrusted to a member of the council, Mr. W. E. de Winton. Mr. de Winton would thus, for the present, take the place of Mr. Clarence Bartlett, who has retired on account of bad health on a pension. This appointment being for a year only would give time for the selection of a new superintendent, who must possess special qualifications such as were not easily to be found. Various buildings, such as the giraffe house, the small mammals' house and the bears' dens, were pointed out as specially requiring reconstruction, and there should be a new seals' pond and better accommodation for the polar bears. Alterations were also recommended at the monkey and antelope houses and in other buildings. A foreman keeper should be appointed to make periodical tours of inspection in the gardens during the day, and the keepers should be forbidden to accept gratuities, to trade in living animals or to keep them without the sanction of the authorities. The prosectorium should be carried on by the present officer in charge (Mr. F. E. Beddard, F.R.S.), but on lines to be laid down by a scientific committee, so that the work should have a more definite object. The prosector should also have a veterinary assistant, who would help in the *post-mortems* and look after the health of the animals in the menagerie. The salary of the new secretary would begin at 600*l.* a year, and his work would be under the supervision of various committees, of all of which the president would be an *ex officio* member. These committees were to be directly responsible to the council. The garden-guide, which the council had formerly granted to the secretary as part of his emolument, had now reverted to the Society, and would be improved and carried on for their benefit.

After the report had been read, the recommendations based upon it and adopted by the council were read from the chair by the president, and it was agreed that they should be printed and sent to the fellows. Notice of a motion was then given by Mr. A. G. Ross that copies of the testimonials tendered to the council by Mr. W. L. Sclater, the newly elected secretary, and by Dr. Chalmers Mitchell (one of the unsuccessful candidates) should be printed and sent to all the fellows. This motion was ordered to be discussed at the next general meeting on February 19.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

AT Bedford College on Thursday, February 5, a lecture on "Electricity and Matter" will be given by Sir Oliver Lodge.

THE first two scholarships at Oxford granted under the terms of Mr. Rhodes's will have just been awarded by the Government of Rhodesia to two students of the Jesuit College in Bulawayo.

THE award of valuable scholarships by private institutions deserves encouragement. We are glad, therefore, to notice that as a result of the recent scholarship examinations, the board of control of the Electrical Standardising, Testing and Training Institution has made the following awards:—To W. H. C. Prideaux, of Shrewsbury School, a Faraday scholarship, value eighty guineas, tenable for two years; to N. S. Smith, of Wellingborough School, an exhibition, value thirty guineas, tenable for two years; to W. d'Arcy Madden, of Haileybury College, and to Frederick Smith, of Aldenham College, special prizes of ten guineas each.

IT is understood that the Carnegie Trust will shortly take active steps to encourage post-graduate research. The present idea is that with the assistance of the Trust, students, after graduating, will be enabled to prosecute thoroughly their particular branches of study. Mr. Carnegie is reported not to consider suitable the post-graduate organisation of Oxford and Cambridge. His scheme will provide no substantial livings. The amount of fellowships, while ample for adequate study, will not be so large as to induce the possessors to cling to them for a livelihood, and, moreover, the fellows will be selected and not ascertained by competition. The fellowships will be directed mainly into the channels of scientific research. Graduates desiring to become fellows will be required to state the class of research they wish to pursue.

THE annual meeting of the Mathematical Association was held on January 24, Prof. A. Lodge in the chair. The report of the committee appointed by the Association to consider the subject of the teaching of elementary mathematics, to which reference has already been made in these columns, was referred to in the council's report for the past year. Prof. Forsyth was elected president for the forthcoming year, and Mr. A. W. Siddons submitted the report of the committee on the teaching of elementary mathematics, which, he said, had been criticised as very conservative. The most immediate need was that the preparatory schools should move in the matter, and they should get the head-masters of such schools to adopt a more modern treatment of mathematics. It would not be done in the public schools unless the boys were taught from the beginning.

In a short discussion which followed, Prof. Forsyth said it was desirable that they should not hurry changes. It did not lie with the public schools or the preparatory schools to make changes. There was a vast body of teachers in the small schools, but the great difficulty was to get at such teachers and induce them to adopt new methods. The report was adopted.

AMONG the many interesting papers read at the conference of the Froebel Society and the Child-Study Association on Saturday was one by Dr. W. B. Drummond, of Edinburgh, who dwelt upon the preparation for child-study as a piece of proper scientific investigation carried on according to modern methods. He laid down that a course of training in biology, that is to say, in the practical study of plants and animals, was the first essential to success. His reason was that the observations made on children are in reality part of biology. Next a course of psychology should follow, and then one in methods of education, for many of these have been based upon an intimate acquaintance with the ways and needs of children. He pointed out how advantage was taken of the peculiarities of the child mind in the Bible, and instanced the setting up of the twelve stones from Jordan so that when they had aroused the curiosity of the children, and this had been satisfied, the monument would always be a reminder to them of the crossing of Jordan as on dry land. The educational results of many celebrations, customs and games which we are ourselves familiar with were touched upon, though it was pointed out that these were not always intentional at the beginning. The danger was pointed out of asking children ill-considered questions which might excite their imagination in a way detrimental to them, or which by suggesting an answer or confusing the young persons might defeat the object of the experiment. During the course of the paper, the characteristics of primeval man were touched upon, as indeed they had been previously during the conference, and in the concluding discussion, Mr. Lewis Paton, head-master of University College School, expressed the opinion that much light could be thrown upon the ways of boys by a study of savages. Another and possibly more serious point was that he found by the time his pupils had reached the age of nine and came to him, their characters were formed or more often deformed, and this is a very strong argument for the advancement of child-study.

AN article by Sir William Ramsay, in the January number of *East and West*, deals with the recent Report of the Indian Universities Commission, and contains several suggestions which ought to be read by all who are interested in the aims and character of university education. The commissioners had not the courage of their convictions, for after forming an accurate conception of the function of a university, they refused to act upon it and accepted old ideals as offering the path of least resistance for the universities of India to follow. As regards the government of the universities, Sir William Ramsay shows that the commissioners could have found abundant precedent for a recommendation that a small number of persons, not exceeding ten, should have been given control of the funds of the university, leaving to the teachers—that is, heads of departments—the entire management of academical affairs. The large number of colleges—many of them really secondary schools—in so-called affiliation with Indian universities presents a difficulty, but the suggestion is put forward that it could be overcome by making the B.A. and B.Sc. degrees, or the former only, equivalent to a leaving examination for secondary schools. Students who wished to pursue their studies would do so at the universities. There would thus be a separation of the college from the university, as in the United States, where numerous colleges give the degrees of A.B. and S.B., and the students afterwards proceed to such places of post-graduate study as the Johns Hopkins University or the university side of Harvard. Some American universities have both college and university sides, but the students in the latter are those proceeding to higher degrees. As to the objection that unless external examiners are called in the examination for degrees by colleges could not be contemplated, Sir William Ramsay urges that the teacher ought to be trusted to gauge the capacity of his students, though it would be advisable for him to act in conjunction with an external examiner for all the colleges to secure uniformity of standard. Finally, he remarks:—"The true prosperity and success of colleges and of universities in training men for their later careers, and in creating and disseminating knowledge, depend on the observance of two fundamental maxims:—First, choose for professors men who have made some reputation and are engaged in active prosecution of research; second, give such men a wide liberty in dealing with their subjects and with their students. Where these maxims have been acted on, university education has been a conspicuous success, and the creation and progress of knowledge have been maintained. May India see fit to adopt and practise these maxims."

SCIENTIFIC SERIALS.

American Journal of Science, January.—The morphogenesis of Platystrophia. A study of the evolution of a Palæozoic brachiopod, by E. R. Cumings.—On ruling concave gratings, by W. Rollins. It has been shown that the Rowland concave gratings give false spectral lines so sharp and clear that there is probability and some evidence that they have been mistaken for real lines. The cause of this is examined, and suggestions are made for a new design of ruling machine in which these defects are overcome. The machine has not yet been constructed.—The variations of potential along a wire transmitting electric waves, by C. A. Chant.—Rickardite, a new mineral, by W. E. Ford. The mineral occurs in the Good Hope mine at Vulcan, Colorado, and consists of a nearly pure copper telluride, Cu_4Te_3.—On the occurrence of free phosphorus in the Saline Township meteorite, by Oliver C. Farrington. The phosphorus was noticed on drilling a hole into the meteorite for the purpose of breaking off a piece, and was proved to exist in the free state by its smell, luminosity, action on silver nitrate and conversion into ammonium phosphomolybdate.

Bulletin of the American Mathematical Society (2), ix., No. 3 (December, 1902).—W. B. Fite, commutator subgroups of groups whose orders are powers of primes.—L. I. Hewes, note on irregular determinants.—G. O. James, on the projections of the absolute accelerations in relative motion.—E. P. Eisenhart, on infinitesimal deformation of the skew helicoid.—S. Epoteen, on integrability by quadratures.—E. B. Wilson, account of the Abel centenary.—Reviews: English and French translations of Hilbert's "Grundlagen der Geometrie" (E. R. Hedrick); Dickson's "Linear Groups" (G. A. Miller); Buckingham's "Thermodynamics" (E. H. Hall).—No. 4 (January, 1903).—F. Cajori, on series whose product is absolutely convergent.—L. E. Dickson, on the abstract simple groups of orders 504 and 660.—C. M. Mason, account of the Carlsbad meeting of the Deutsche Mathematiker-Vereinigung.

SOCIETIES AND ACADEMIES.

LONDON.

Anthropological Institute, January 13.—Dr. A. C. Haddon, F.R.S., in the chair.—Dr. C. S. **Myers** read a paper on the future of anthropometry. He suggested that the work in which anthropometry had hitherto been concerned, viz. the determination of the average metric differences between the various peoples of the world, must ultimately yield before improved methods and new problems. The frequency-distribution of any one character in a series of individuals must be studied with greater accuracy. The mean of the deviations of individuals from the mean of the whole series and the form of the binomial frequency-curve require to be determined both for relatively pure and mixed peoples. Frequency-curves will almost invariably show more than one point of maximal frequency. But before the usual inference is drawn that these several peaks represent heterogeneous elements in the series, care must be taken that the irregularities of distribution are not the result of examining an insufficient number of individuals. The future will see the precise investigation of the degree of correlation of various characters, the mode of inheritance of characters, the fertility and characters of cross-breds, and the effect of migration and evolution on mankind. Mr. Francis Galton, Prof. Karl Pearson and others have already made a start. Anthropometry has first to look for aid to the infant science of biometry, which can employ experimental and therefore simpler conditions. The whole study of natural history is passing from the descriptive to the quantitative aspect. In this, physical anthropology must join.

Royal Meteorological Society, January 21.—Mr. W. H. Dines, president, in the chair.—The **President** delivered an address on the method of kite-flying from a steam vessel and meteorological observations obtained thereby off the west coast of Scotland. In the spring of 1901, the Royal Meteorological Society appointed a committee for the purpose of making an investigation as to the temperature and moisture of the upper air, and the British Association, at the Glasgow meeting, also appointed a committee to cooperate in the work. At the request of the joint committee, Mr. Dines undertook to carry on the inquiry during the summer of 1902, and in this address he gave an interesting account of all that he had done. After describing the apparatus, which included kites (of a modified Blue Hill pattern), eight miles of wire in one piece, winding-in apparatus, steam engine and meteorograph, he proceeded to give an account of his work and observations at a fixed station, and also from a steam tug, in the neighbourhood of Crinan off the west coast of Scotland. A considerable amount of information concerning meteorological phenomena was obtained, seventy-one observations of temperature at an average height of 4140 feet and thirty-eight charts from the self-recording instruments with an average of more than 6000 feet having been secured. The greatest height attained was 15,000 feet, by means of four kites on the wire. The temperature gradient over the sea was considerably less than its average value over the land, being about 1° for every 300 feet of height. The upper currents were found to differ in direction from those below much less than was expected. As a general rule, the humidity increased up to a level of about a mile and then decreased. Mr. Dines illustrated his address with a number of interesting lantern slides.—Captain D. Wilson-Barker was elected president for the ensuing year.

Entomological Society, Annual Meeting, January 21.—The Rev. Canon Fowler, president, in the chair.—Canon **Fowler**, the retiring president, in the first part of his address dealt chiefly with the many facts that have been recently brought forward with regard to cryptic coloration and mimicry, more especially as affecting the order Coleoptera; the facts are indisputable, but the hypotheses founded upon them are, perhaps, sometimes pressed too far. In the second part, the question of the origin of the Coleoptera was discussed; there is no satisfactory evidence of the appearance of the order in the Palæozoic period, but the leading families are found in the Lias, as completely differentiated as at the present time; in fact, many of the genera and even the species are almost identical with those now living; the Coleoptera, that is to say, have altered but little from the time at which they existed side by side with the gigantic extinct saurians and the pterodactyles; the whole question of the origin and history of the insects generally is of the first importance in the history of evolution.

PARIS.

Academy of Sciences, January 19.—M Albert **Gaudry** in the chair.—Notice on the work of the late M. Sirodot, by M. **Bornet**.—Researches on the chinchona alkaloids, by MM. **Berthelot** and **Gaudechon**. A thermochemical paper, giving the heats of combustion and formation of quinine and quinidine, together with the heats of solution of several salts of these alkaloids. Attention was paid to the influence of the physical condition of the quinine, the value obtained with quinine which had been recently precipitated being slightly different from that given by quinine which had been precipitated for some days. The isomer quinidine proved to have the same function, the same heats of formation and of neutralisation.—On some formulæ of kinematics useful in the general theory of elasticity, by M. P. **Duhem**.—The coloured drawings on the walls of the cave of La Mouthe, forming true decorative panels, by M. Emi **Riviere**. The antiquity of the numerous drawings and paintings on the walls of this cave has been verified by the anthropologists of the Congress of the French Association for the Advancement of Science. The drawings have been identified as certainly dating from the Quaternary epoch. They are contemporary with the *Tarandus rangifer*, *Ursus spelaeus* and *Hyaena spelaea*. The extreme freshness of some of the drawings threw some doubt on their authenticity, but it has been shown that these are covered with the same clay as the others. A detailed account of the drawings uncovered up to the present is given, and the work is being continued.—On a colouring matter from the figures in the cave of La Mouthe, by M. Henri **Moissan**. The black colouring matter, freed from particles of silica and chalk, proved to consist entirely of an oxide of manganese. It is similar to that discovered by MM. Capitan and Breuil in the cave of Font de Gaume.—On the reducibility of differential equations, by M. R. **Liouville**.—On the universal functions of the plane and surfaces of Riemann, by M. A. **Korn**.—On the surfaces which correspond with parallelism of the tangent planes and conservation of areas, by M. C. **Guichard**.—The proof of a rotating electromagnetic field produced by a helicoidal modification of stratifications in a tube of rarefied air, by M. Th. **Tommasina**. The facts described correspond with the view of the anodic origin of these phenomena and the part played by reflection in the anode modification. It is pointed out that if the charges are transmitted along the helicoidal bundle, this should behave as a solenoid carrying a current. In this case, the bundle which would be the deviable bundle should turn under the action of the other part of the current which passes along the non-deviable bundle, precisely like a movable solenoid turning round a fixed linear current.—On the so-called electrolytic reduction of potassium chlorate, by M. André **Brochet**. A criticism of a paper by Bancroft and Burrows. The author is in general agreement with the experimental part of this work, but arrives at quite different conclusions regarding the true explanation of the phenomenon. The reduction he regards as being produced by a secondary and purely chemical reaction, and hence concludes that the reduction is not electrolytic properly so called.—On a mode of formation of phenols, by M. F. **Bodroux**. Phenyl-magnesium bromide and the corresponding derivatives of other aromatic hydrocarbons are slowly acted upon by dry air, and from the product of this reaction, after acidifying with hydrochloric acid, phenols can be extracted. Working in this way, phenol has been obtained from bromobenzene, and ortho- and para-bromotoluene have been transformed into the corresponding cresols. From monobromanisol, the monomethylether and hydroquinone were obtained, parabromophenetol behaving similarly. The yields are small, varying from 5 to 10 per cent. of the theoretical.—On ethyl dinitroacetate, by MM. L. **Bouveault** and A. **Wahl**. This compound has been obtained by the action of ordinary fuming nitric acid upon the acid ethyl ester of malonic acid, carbon dioxide being given off. The physical and chemical properties of the nitro-compound are given, and the preparation of the ammonium salt described.—The influence of the nature of the external medium on the state of hydration of the plant, by MM. Eug. **Charabot** and A. **Hebert**. The effect of the addition of a salt of a mineral acid to the soil is to accelerate the diminution of the proportion of water in the plant. The nitrates have the most powerful effect in causing the loss of water, then follow sulphates, chlorides and finally sodium phosphate.—Observations on the theory of cell division, by M. P. A. **Dangeard**. The primitive laws of cell division are found to be modified by the appearance of a membrane or an inextensible envelope; the laws of Hertwig and Pflueger only give expression to this modification interposed in the cellular structure in the course of development.—The existence of the lower Cretacean in Argolide, Greece, by M L. **Cayeux**.—On the presence of a kinase in some Basidiomycetes, by MM. C. **Delezenne** and H. **Mouton**. The powdered fungus is extracted with saline water (0·8 per cent.) in presence of toluol, and the liquid filtered either through paper or a Berkefeld filter, the extract from *Amanita muscaria* giving the best results. This extract, which is inactive towards albumen, when mixed with a pancreatic juice also inactive by itself, is capable of rapidly digesting albumen. The effects are produced by a soluble ferment analogous to enterokinase.—The influence of the stereochemical configuration of glucosides on the activity of the hydrolytic diastases, by M. Henri **Pottevin**. An examination of some apparent exceptions to the law of Fischer.—Acetaldehyde in the ageing and alterations of wine, by M. A. **Trillat**. Acetaldehyde appears to play an important part in the various modifications undergone by wine. The ageing corresponds to a normal oxidation of the alcohol of the wine, resulting in the formation of aldehydes, their transformation into acetals and esters. Under the influence of certain diseases, the proportion of aldehydes increases; according to the conditions, these aldehydes may either form an insoluble compound with the colouring matter or may be resinified by the action of the mineral salts of the wine.—The comparative bactericidal power of the electric arc between poles of ordinary carbon or of carbon containing iron,

by MM. Alfred **Chatin** and S. **Nicolau.** The arc with iron has always a greater bactericidal power than the arc between ordinary carbon poles, the effect being most marked with the staphylococcus aureus and least with the anthrax bacillus, but even in the latter case the ratio of the times required for sterilisation was as 5 : 1 in favour of the poles containing iron.—Researches on the toxic power of *Ksopo* or *Tanghin de Menabe*, by M. Lucien **Camus.**—The origin of pearls in *Mytilus gallo-provincialis*, by M. Raphaël **Dubois.**

NEW SOUTH WALES.

Royal Society, November 5, 1902.—Prof. Warren, president, in the chair.—New South Wales Meteorites, by Prof. **Liversidge,** F.R.S. *Barratta Meteorites*, Nos. 2 and 3. The first meteorite from this locality was examined by the author in 1872; the later ones were received in 1889. No. 2 weighed 31½ lb. and No. 3 48 lb.; they both very closely resemble the first one found in appearance, specific gravity, &c. No. 2 has, on analysis, been found to resemble No. 1 also in chemical composition; it is essentially a mixture of enstatite, olivine, &c., with about 6 per cent. of nickeliferous iron. No. 3 has not yet been analysed. *Gilgoin Meteorites*, Nos. 1 and 2. The weight of No. 1 was 67½ lb. and its sp. gr. 3·857. They are both much fissured and weathered. No 2 weighed 74 lb. and has a sp. gr. of 3·757. No. 1 has been found on analysis to resemble the Barratta meteorites, but to contain more lime and alumina, and less iron and magnesia and about 14 per cent. of nickeliferous iron. No. 2 has not yet been analysed. *Boogaldi* (*Bugoldi*) *Meteorite*. An account of this meteorite was given by Mr. R. T. Baker about two years ago; it has since been analysed; the principal constituents are iron 91·135, nickel 8·636, cobalt 0·065 and phosphorus 0·17.—Forests considered in their relation to rainfall and the conservation of moisture, by Mr. J. H. **Maiden.** A descriptive statement of the relation between forests and water supply. Some uses of forests are, (*a*) to temper floods; (*b*) to conserve springs and to aid in the more even distribution of terrestrial waters; (*c*) to prevent evaporation of water; (*d*) to give shelter to stock, crops, &c.; (*e*) the leaves of forest trees, &c., afford manure and mulch.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 29.

ROYAL SOCIETY, at 4.30.—The Relation between Solar Prominences and Terrestrial Magnetism: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer.—The Bending of Electric Waves round a Conducting Obstacle: H. M. Macdonald, F.R.S.—On Skew Refraction through a Lens; and on the Hollow Pencil given by an Annulus of a very Obliquely Placed Lens: Prof. J. D. Everett, F.R.S.—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Temperature: Miss S. C. M Sowton and J. S. Macdonald.

ROYAL INSTITUTION, at 5.—Pre-Phœnician Writing in Crete and its Bearings on the History of the Alphabet: Dr. A. J. Evans.

FRIDAY, JANUARY 30.

ROYAL INSTITUTION, at 9.—Vibration Problems in Engineering Science: Prof. W. E. Dalby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of the Electrical Equipment of a Light Railway: J. R. MacIntosh.

SATURDAY, JANUARY 31.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30.—Proposals for a Photographic and Pictorial Survey of Essex: A. E. Briscoe.

MONDAY, FEBRUARY 2

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

VICTORIA INSTITUTE, at 4.30.—On the Unseen Life of our World, and of Living Growth; Design, Human and Divine: Prof. Lionel S. Beale, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Statistics of British and German Chemical Trades for 1901, with Suggestions for Improving the Official Tables: F. Evershed.—The Standardisation of Analytical Methods: H. Droop Richmond.

TUESDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

SOCIETY OF ARTS, at 8.—Technical Education in Connection with the Book-Producing Trades: Douglas Cockerell.

MINERALOGICAL SOCIETY, at 8.—(1) On a Meteoric Stone seen to fall on August 22, 1902, at Caratash, Smyrna; (2) Note on the History of the Mass of Meteoric Iron found in the Neighbourhood of Caperr, Patagonia: L. Fletcher, F.R.S.—On the Crystalline Forms of Carbides and Silicides of Iron and Manganese: L. J. Spencer.—The Refractive Indices of Pyromorphite: H. L. Bowman.—Note on Quartz Crystals from De Aar: T. V. Barker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion of papers on* The Nile Reservoir, Assuan: M. Fitzmaurice, C.M.G.—Sluices and Lock-Gates of the Nile Reservoir, Assuan: F. W. S. Stokes.

ZOOLOGICAL SOCIETY, at 8.30.—On the Hair-slope of four Typical Animals: Dr. W. Kidd.—A Prodromus of the Snakes hitherto recorded from China, Japan and the Loochoo Islands: Capt. F. Wall.—On the Variation of the Elk: H. J. Elwes, F.R.S.—Note on the Wild Sheep of the Kopet Dagh: R. Lydekker, F.R.S.

WEDNESDAY, FEBRUARY 4.

SOCIETY OF ELECTRO-CHEMISTS AND METALLURGISTS (Faraday Club, St. Ermin's Hotel, Westminster), at 5.—General Meeting to inaugurate the work of the Society and elect a President and Council.

SOCIETY OF ARTS, at 8.—Methods of Mosaic Construction: W. L. H. Hamilton.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—At 8.30.—The Determination of Glycerine in crude Glycerines: Dr. Julius Lewkowitsch.—(1) A Plea for the more Extended Consideration of Physics in Analytical Methods; (2) Note on the Determination of Casein precipitated by Rennet: H. Droop Richmond.

ENTOMOLOGICAL SOCIETY, at 8.—An Account of a Collection of Rhopalocera made on the Anambara Creek in Nigeria, West Africa: Percy I. Lathy; On the Hypsid Genus Deilemera, Hübner: Colonel C. Swinhoe.

GEOLOGICAL SOCIETY, at 8.—(1) The Granite and Greisen of Cligga Head (West Cornwall); (2) Notes on the Geology of Patagonia: J. B. Scrivenor.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—The Brain of the Archæoceti: Prof. Elliot Smith.—On the Negative Variation in the Nerves of Warm-Blooded Animals: Dr. N. H. Alcock.—Primitive Knot and Early Gastrulation Cavity coexisting with Independent Primitive Streak in Ornithorhynchus: Prof. J. T. Wilson and J. P. Hill.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

CHEMICAL SOCIETY, at 8.—(1) A New Vapour-Density Apparatus; (2) A New Principle for the Construction of a Pyrometer: J. S. Lumsden.

LINNEAN SOCIETY, at 8.—Stephanospermum, Brongniart, a Genus of Fossil Gymnospermous Seeds: Prof. F. W. Oliver

RÖNTGEN SOCIETY, at 8.30.—Discussion on Some Points suggested by the Presidential Address of November, 1902, opened by J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Adjourned Discussion on the Metric System.

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THURSDAY, FEBRUARY 5, 1903.

INDIA-RUBBER.

The Chemistry of India-rubber. By Carl Otto Weber, Ph.D. Pp. x + 314. (London: Chas. Griffin and Co., Ltd.). Price 16*s*. net.

DURING the last few years the development of the india-rubber industry to meet cycling, motoring, and electrical requirements has produced quite a crop of descriptive handbooks, among which those of Brannt, Henriques, Seeligmann, Clouth and Warburg are the works which come most readily to mind. As a rule, however, these treatises have dealt more particularly with the manufacturing and commercial aspects of india-rubber production, and the scientific side of the subject occupies in them a relatively subordinate place as one matter among many. In the volume before us, the author has applied himself specifically to the chemistry of india-rubber, and incidentally to that of its various substitutes. Dealing, as he does, with only the scientific portion of the subject, he has naturally treated this branch far more exhaustively than previous writers have done. But pure science is even here tempered to the technologist, for almost throughout the book the point of view is that of the working—one had almost said of the works—chemist. Theoretical exposition and practical application jostle one another in every chapter; what to do, and the reason for doing it, rub shoulders together from cover to cover. It may be said at once that the result is an eminently useful contribution to the literature of india-rubber and its congeners.

The book contains nine chapters and an appendix. In the first chapter, which forms more than a third of the work and gives its title to the whole, Dr. Weber deals with the constituents of india-rubber, discusses their physical and chemical properties, and propounds in outline a theory of vulcanisation. The carbohydrates present in crude "unwashed" rubber are first referred to, and then follows a useful little table showing the proportions of resinous extract obtained from the various commercial brands of technically-pure rubber by treatment with acetone. It may be explained that the importance of these "resins" lies in the fact that they allow the chemist to discriminate between a high-quality rubber, such as Pará, and an inferior product like some of the African kinds.

Passing on to india-rubber proper, the author summarises the evidence which goes to prove that the pure rubber substance is a hydrocarbon of the terpene type. Oxygen, it is true, is always present in commercial specimens, but it is partly accounted for by atmospheric oxidation and partly by the presence of an "insoluble" compound having the empirical formula of a hydrated terpene. This last, the author suggests, may be an intermediate product between india-rubber itself and the carbohydrates from which, perhaps, the various terpenes are manufactured in the cells of the rubber plant.

Organic chemists have apparently found the chemistry of india-rubber somewhat unattractive. Gladstone and Hibbert's well-known paper, published some fifteen years ago, still remains the chief contribution to the subject. No doubt this is largely due to the intractable nature of the compound; for india-rubber, from this point of view, certainly possesses the defects of its qualities. It has few points of attack; there are none of the carbonyl-, carboxyl-, amido-, imido-, hydroxy- or methoxy-groups in which the organic manipulator delights; it cannot be readily dissolved; and *a fortiori*, being a colloid, it cannot be crystallised. Nevertheless, it has one vulnerable spot, and the Achilles' heel in this case is found in the existence of the "ethylene bonds" pointed out by Gladstone and Hibbert in the paper already referred to. The advances that have been made in the chemistry of this refractory substance have followed almost exclusively from the study of india-rubber as an "unsaturated" compound. From a consideration of its addition-products, our author concludes that the india-rubber molecule has probably an open-chain structure, and that its molecular weight corresponds, in all likelihood, to a high multiple of the empirical formula $C_{10}H_{16}$, with $C_{50}H_{80}$ or $C_{60}H_{96}$ as a possible minimum.

Much stress is laid upon the colloidal properties of rubber as being the clue to a proper understanding of its behaviour during manufacture. Graham's classical researches on colloids we are all supposed to know, at least in substance; but Dr. Weber appears to think—perhaps justly—that most of us are content to take them as read, since he remarks that they are, if not forgotten, certainly realised by very few present-day workers. For our sins in this respect we are treated to a twenty-five page disquisition on the colloidal state, leading up, however, to an interesting study of the phenomena of vulcanisation.

In the author's view—the experimental evidence for which is set out at some length—the vulcanisation of india-rubber by means of sulphur consists essentially in the direct addition of sulphur to the india-rubber hydrocarbon (polyprene), with the formation of various polyprene sulphides ranging between the limits $C_{100}H_{160}S$ and $C_{100}H_{160}S_{20}$. The particular sulphide produced depends upon the degree of vulcanisation, which itself is a function of the temperature, time, and proportion of sulphur present. Combating the theory that the action of the sulphur is one of substitution instead of addition, the author rightly points out that if the former were the case the vulcanisation of a ton of rubber would mean the production of about 18,000 litres of hydrogen sulphide—a daily amount which would make the vulcanising rooms fairly reek with the gas. In reality, only insignificant traces are found there. The cold process of vulcanising by means of sulphur chloride is also discussed in detail; alternative methods are mentioned, and the whole section, which is embellished by half-a-dozen photo-micrographs, forms a highly interesting and suggestive little monograph upon the inter-relations of sulphur and rubber.

In the succeeding chapter the technical examination and valuation of india-rubber and gutta-percha are dealt with. But in this industry, as in so many others, our manufacturers cling hard to rule-of-thumb methods; stocks are bought on the strength of a cursory empirical examination; and we read that, in consequence, different lots, supposed to be of identical quality, "often show the most absurd variations" when properly appraised by analysis. The following quotation speaks for itself:—

"Pig iron, caustic soda, wood pulp, and scores of similar articles, costing, comparatively speaking, a few shillings per ton, are bought and sold on the basis of strict analytical standards; but india-rubber, costing from 150*l*. to 500*l*. per ton, changes hands without either buyer or seller having more than a vague knowledge of its intrinsic value."

A full description is given of the various india-rubber substitutes now so frequently used, and which consist either of recovered rubber from cast-off articles or of the products obtained by the action of oxygen, sulphur or sulphur chloride upon such substances as linseed or colza oils. Inorganic compounding materials, vulcanising agents, solvents, colouring matters and textile fabrics each claim a chapter; and, as might be expected from a writer of Dr. Weber's experience and attainments, the treatment of all these subjects is eminently practical without in any degree lacking scientific precision.

Analysts and technical chemists who are called upon to examine india-rubber will be grateful for the chapter on the analysis of rubber articles, with which the volume proper closes. Information previously scattered in periodicals is here readily available, and the usefulness of the chapter is much enhanced by a section dealing with the interpretation of analytical results. Chemists should note that nitro-naphthalene is recommended as a "solvent" for india-rubber in preference to the nitro-benzene hitherto generally employed.

On the whole, the author's style is lucid and his English readable. Occasionally one meets with a tortuous sentence or a quaint prepositional usage, and the book generally, perhaps, lacks lightness of touch. Here and there, also, a word occurs which does not exactly convey the meaning intended, and rather reminds the present writer of the youthful essayist who, describing a storm at sea, remarked that a boy was drowned before his parents' eyes, and that "it was all the more awful because the father and mother were just on their honeymoon." Such blemishes, however, are small matters in a work of this kind. The book was wanted, and is a welcome acquisition. It is written by a man who knows his subject and who writes as if he loved it. The author is to be congratulated upon a very useful contribution to a somewhat obscure and difficult branch of technical science.

C. SIMMONDS.

A BRITISH BOOK OF CONSTANTS.

Physico-Chemical Tables. Vol. I. *Chemical Engineering and Physical Chemistry.* By John Castell-Evans F.C.S. Pp. xxxii + 548. (London: Chas. Griffin and Co., Ltd.) Price 24*s*. net.

THIS volume is the first half of an elaborate work intended to be a compendium of tables and data covering the whole domain of physical chemistry, for use both in the laboratory and the works. The scheme is an ambitious one, and the labour of compiling the present 548 pages of closely printed matter must have been no light task. The book which Mr. Castell-Evans's work most closely resembles is undoubtedly Landolt and Börnstein's well-known treatise, which is about the only one with which the writer is acquainted covering the same field. The chief difference between the two books lies in the fact that Mr. Evans has included about sixty pages of arithmetical and algebraical data, which should prove quite useful.

The book is, on the whole, well arranged and exceedingly comprehensive, and some of the original tables it contains are among the best. The reviewer feels, however, that one of its chief demerits lies in the over-elaboration of some matters and the very unnecessary rows of figures, which many of the tables give.

For instance, what possible significance can the last two or even three figures have, when from table 47 G we learn that a barometer column of 30 inches at 54° F. is equivalent to 29·940213 inches at 32° F.? or of what use is it to have the equivalent of a mile in metres given to fourteen significant figures when 10^{-8} metre is about the limit attainable in the comparison of primary standards of length of the highest class?

Regarding the material of the work as a whole, a careful perusal gives a general impression that the author collected his materials and retired into his study to write his book six or eight years ago, and when the book came to be published overlooked the fact that our knowledge of some of the most important questions dealt with has advanced very materially during this period. For instance, we look in vain, under the specific heat of water or mechanical equivalent of heat, for mention of the work of Griffiths, of Schuster and Gannon, of Callendar and Barnes, or of Reynolds and Moorby, whose different researches, all published during the past few years, have practically settled this question. While dealing with this point, we notice that there occurs here in the familiar form the good old text-book tradition that Regnault *determined* the specific heat of water between ordinary temperatures and 100° C. In justice to Mr. Evans, however, we should mention that in his book several other similar errors, which we had come to recognise as almost always with us, are conspicuous by their absence, and the book bears strong evidence that in a great many cases the original authorities have been consulted.

We have verified many of the numbers, and have not detected many serious errors properly so called. In some cases, however, this may be due to the decided superabundance of data in many of the tables (as, for example, that of melting points on pp. 380, *et seq*). We find there for the melting point of gold,

1140°, 1200°, 1037°, 1092°, 1240°, 1250°, 1380°, 1100°, 1035°, 1045; most probable value 1050°;

and for silver,

999°, 1024°, 1000°, 1032°, 916°, 1023°, 1040°, 954°, 968°; most probable value 968°;

whereas modern authorities are agreed that 1062 ± 2° is a close approximation for the melting point of gold, that of silver in a reducing atmosphere being very sensibly 100° lower.

The most commendable part of the book is the section dealing with vapour pressures, critical volumes, &c., the results of the voluminous researches of Ramsay and Young and other modern workers being here, with both formulæ and tables, given in full.

In conclusion, we congratulate the author on having carried out so formidable a task as the compilation of these tables apparently single-handed. Should a second edition be necessary, revision of some parts and condensation to two-thirds its present bulk would make it a decidedly useful work. J. A. H.

OUR BOOK SHELF.

Natural and Artificial Sewage Treatment. By Jones and Roechling. Pp. vii + 96. (London: Spon, 1902.)

The authors state that they are making public in the above treatise information which they have already brought before different societies of professional men, but they claim that while putting the matter forward in a new form, they have also brought it up to date. This is doubtless the case with the statements concerning treatment of sewage on the land, but the treatment by bacteria beds is not so satisfactorily brought up to the date of publication. In fact, the impression produced by a careful perusal of the book is that the presentation of the two methods of treatment by land and by bacteria tanks and beds is such as to indicate a very considerable predilection for the sewage farm. This impression is caused, not by an overstatement of the results of sewage farming, but by an understatement of the permanency and advantages of an artificial bacterial installation. The authors do not lay stress, as they should in fairness do, on the fact that what they term the "artificial" bacterial treatment is the bacterial treatment of the sewage farm carried out under regulated and controlled conditions which add much to the precision, uniformity and regularity of the process of purification. When they place to the advantage of land treatment that it removes pathogenic germs, they are on doubtful ground; and when they speak of the entire loss of manurial value and the production of larger volume of effluent by the artificial bacterial process as disadvantageous, they apparently forget that bacterial effluents are not infrequently directly or indirectly used in certain parts of the year for irrigation, and further, that a larger volume of good effluent turned into a watercourse is usually of direct advantage.

Some statements are, moreover, open to serious question and have not been decided in the sense stated. Such is the oft-repeated one that treatment of ordinary sewage causes bacteria beds rapidly to silt up and that their material requires renewal, that their capacity is not permanently increased by resting, that they are peculiar in requiring careful management and that a covering of scum is necessary to the action in the so-called "septic tank." It should have been stated that beds which silt up are either improperly constructed, are being improperly treated or are receiving abnormal sewage, and that bacterial treatment, whether effected on land or in artificially constructed spaces, is identical in its cause and its nature and requires similar considerate management. Both processes have frequently failed because they have been inconsiderately provided for and dealt with.

If the above considerations are borne in mind, "district councillors, sanitarians and all interested in this complicated process" may with advantage peruse the little book, and they will find that, in the second part more especially, information of real value is presented in a lucid and intelligible form.

It might have been anticipated from the title of the book that chemical processes of treatment received notice. It is satisfactory to find that they are not dealt with, and that the terms "natural and artificial," as applied to sewage treatment, are intended to refer to land treatment and to so-called bacterial treatment respectively. It should be remembered that both these treatments are "naturally" effected in the main by the bacteria present in the sewage itself, and that the laying out of a sewage farm is as truly artificial as the provision of beds of flints, pebbles or other materials for so-called contact treatment.

Thomson's Gardener's Assistant. New Edition. Pp. viii + 607. (London: The Gresham Publishing Company, 1900–1902). Six Vols., 8*s*. each.

This important horticultural work, revised and entirely remodelled under the able direction and general editorship of Mr. W. Watson, Curator, Royal Gardens, Kew, has now been completed. It has been published in six divisional volumes, or in two volumes of 656 and 607 pages respectively. Many specialists have contributed to the work, and a glance at a list of their names with the articles for which they are severally responsible is sufficient to prove the value of this great addition to the literature of gardening.

Divisional vol. i. contains about forty pages on "Plant Structure," an epitome of such portions of botanical science as are of most interest to the gardener, by Dr. M. T. Masters. "Insect and other Plant Enemies," as also an article on "Garden Friends," are well treated by Mr. J. Fraser. Mr. G. Massee, our greatest authority, writes on "Plant Diseases caused by Fungi." All these articles are well illustrated and clearly and pleasantly written. Soils and manures are treated at length by Mr. Willis. Tools and instruments and garden structures are thoroughly dealt with, described and, when desirable, illustrated—the underlying principles being explained in a concise and lucid manner.

Divisional vol. ii. has articles, all well illustrated, on heating, propagation, transplanting, pruning, flower-garden and pleasure-grounds, hardy ornamental trees and shrubs, hardy herbaceous perennials, aquatic and bog plants, hardy and half-hardy annuals and popular garden plants.

Divisional vol. iii. treats on the greenhouse and conservatory, gives a select list of desirable stove and greenhouse plants with full cultural details. The orchids are fully treated by Mr. J. O'Brien, a descriptive list of the more important ones from a garden standpoint being given, together with full particulars as to their requirements and cultivation; plans of orchid houses even are given. Other special articles are those on ferns, palms and cycads, succulent plants, summer bedding, the subtropical garden, floral decorations, &c.

The remaining three divisional volumes deal fully and carefully with the fruit and kitchen garden. Lists of the best varieties are in each case given, and in some instances, under "Asparagus," for instance, the methods pursued by present-day market cultivators near London, and also about Paris, are described pretty fully.

Calendarial directions for each department of the garden for each month are contained towards the close of the last volume, in which are also treated the best methods of collecting, packing and storing vegetables, &c.

We think that, taken altogether, the present edition of "Thomson's Gardener's Assistant" may fairly be regarded as the standard book on British gardening.

G. N.

Proceedings of the Aristotelian Society. New Series. Vol. ii. Pp. 240. (London: Williams and Norgate, 1902.)

This collection of papers read before the Aristotelian Society during the session 1901–2 maintains the decidedly high level reached by previous volumes. For the professed metaphysician there will be special interest in the essays of Dr. G. F. Stout and Mr. H. W. Carr, who both take up, though on rather diverging lines,

the task of disproving some of the contradictions discovered by Mr. F. H. Bradley in the "appearances" with which both popular and "scientific," as distinguished from philosophical, thought do their work. Dr. Stout's paper is specially important, as it deals with the concept of "relation," which is central for all discursive thinking. Mr. G. E. Moore discusses at great length and with considerable acuteness, though not, perhaps, without a tendency to *ignorantia elenchi*, the argument for human immortality put forward in Dr. McTaggart's recent "Studies in Hegelian Cosmology." Mrs. Bryant's paper on the relation of mathematics to general formal logic, though far from easy reading, should be valuable to all who are interested in the problems of general scientific method. Unfortunately, it is disfigured by several misleading errors in the printing of symbols. Dr. Bosanquet supplies a most instructive defence of the ethical doctrines of T. H. Green against recent criticism. For the reader who is interested in topics of a more general kind, there are Mr. Boutwood's "Philosophy of Probability" and Mr. Goldsbrough's essay on "The Ethical Limits of Method in Philosophy." A. E. T.

Directions for Laboratory Work in Physiological Chemistry. By Holmes C. Jackson, Ph.D., Instructor in Physiological Chemistry, Bellevue Hospital Medical College. Pp. 62. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.)

THIS little book is intended especially as a guide to the author's own students, and it is a little difficult to understand why it should have a wider circulation. Every teacher has necessarily his own methods, and if all of them were to publish their own rough notes, the number of text-books would be endless. If there is marked originality in any particular teacher's methods, or if he has anything new and important in his material, there would be an excuse for publication, and other students and other teachers would then derive benefit from the book, but in the present case it is impossible to find any such reason. All one finds are directions for performing the stock elementary experiments commonly performed in practical classes. There is no pretence at completeness. The only spark of originality the work possesses is its incompleteness; each exercise is studded with marks of interrogation or terminated by a question or two. These, we imagine, are to be filled in or answered on the blank pages with which the book is interleaved. The student will, therefore, require a second book, or a very inquiring mind, in order that he may give the present note-book any semblance of completeness.

We imagine that the purpose of leaving out so much needful information is to stimulate the pupils to inquire for themselves. Such a method only appeals to the better class of student. It is the rank and file that a book such as this should aim at educating; the best students will find things out for themselves whatever method they are taught by.

The style of the book is as rough as its matter is incomplete; it is written in the note-book or blackboard manner, of which brevity is the soul, and in which such parts of speech as articles, nominatives and verbs are not regarded as essential constituents of a sentence. We have not come across anything in the shape of serious error, but that is hardly to be expected from a teacher of some experience; and doubtless many a first-year's student could write notes of his practical work which would be equally free from mistakes of this nature.

Die Zersetzung stickstofffreier organischen Substanzen durch Bakterien. By Dr. O. Emmerling. Pp. 151 + plates. (Braunschweig: Friedrich Vieweg u. Sohn, 1902.) Price 4 marks.

THIS book is the outcome of a series of lectures delivered by the author before a chemical audience, and is primarily intended for chemists, but is also adapted for all interested in the subject from a physiological standpoint. The treatment is in nature, but not in form, that of a lexicon, being a compilation which is intentionally incomplete, and practically devoid of critical observations and considerations of theory or method.

The work is divided into six sections—(1) fermentations accompanied by oxidation; fermentations yielding (2) lactic acid; (3) mucilage (*Schleim*); (4) butyric acid; (5) fermentation of cellulose; and (6) partly-unexplained fermentations. The fermented substances considered are practically entirely carbohydrates.

Of the 132 pages of text, sixty-one fall to lactic fermentation and, roughly, fifteen each to fermentations accompanied with oxidation, those yielding mucilage and butyric acid respectively, while that of cellulose receives seven.

The general mode of treatment in each section is enumeration of the more important organisms, with a short account of their characteristics, the subsidiary products of the fermentations and substances other than the specific one fermented by the organisms.

In the sections on lactic and butyric fermentations, two acceptable tables occur. These are divided into sections according with the compound fermented. Each section is divided into three columns, giving respectively the names of the organisms, the subsidiary products and the names of the authors responsible for the statements. In the case of lactic fermentations, the photogyric nature of the resulting acids is given.

The economic aspect of lactic fermentations is considered somewhat briefly, but comprehensively. The section devoted to partly-explained fermentations is practically only an enumeration.

The author constantly uses the word fungus (*Pilz*) as equivalent with Schizomycete, a fault that is botanically inexcusable. He also states that respiratory processes, in which small amounts of sugars are decomposed with production of natural gases, are to be strictly separated from fermentation. This is physiologically erroneous.

Seven photographic plates occur at the end. The figures are, on the average, good, although the focus of some is not perfect. The book will be useful to all who desire a partial summary of recent work on this subject within a small scope. F. ESCOMBE.

Das Motor-Zweirad und seine Behandlung. By Wolfgang Vogel. Pp. vii + 154. (Berlin: Gustav Schmidt, 1902.)

A NOTICE of Herr Vogel's "Schule des Automobilfahrers" appeared in NATURE of July 31, 1902 (vol. lxvi. p. 313), and reference was made in it to the motor cycle. In the little manual before us, the same author describes concisely the theory and action of the motor bicycle, and provides in text and illustration just the kind of information which the motorist will find of service. To readers familiar with German, the book will give many useful particulars on the construction of the machine and hints on its care and use.

A Course of Simple Experiments in Magnetism and Electricity. By A. E. Munby, M.A. Pp. xvi + 90. (London: Macmillan and Co., Ltd., 1903.) Price 1*s*. 6*d*.

THE careful instructions for the eighty-five experiments contained in this little book, together with the useful hints for the construction of apparatus, should serve very well to introduce young pupils to the practical study of magnetism and electricity. The author gives just enough guidance in the form of statements and suggestive questions to ensure that the experiments will be performed intelligently.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Holy Shroud of Turin.

WHILE thoroughly agreeing with Prof. Meldola's remarks regarding Dr. Paul Vignon's *étude scientifique* of the remarkable relic known as the Holy Shroud, reviewed at p. 241 of the current volume, there are a few points which he has not enlarged upon, but which may possibly deserve attention and show how largely imaginary and unsupported by the records Dr. Vignon's theory is. No valid determination of the nature of the impressions or of the manner in which they have been produced can, of course, be made without a critical examination of the relic itself, so that any arguments based upon mere assumptions must be purely hypothetical.

First, as regards the possibility of the negative impressions being produced by painting or some analogous method. Dr. Vignon rejects this absolutely on the ground that no one in the Middle Ages had the knowledge for producing them by handicraft, the difficulty of producing a negative picture pictorially or of painting on linen with gum or albumen as media without the colour flaking off, while the linen is too supple to have been painted in oil. If he had consulted the early treatises on painting, some of them dating from long before the fourteenth century and handing down processes derived from ancient Greek art, he would have found descriptions of methods of tracing and transferring pictures which might have modified his opinion. For instance, in Didron's "Manuel d'Iconographie Chrétienne," which contains a translation of a treatise on painting founded on the teaching of the twelfth-century painter Manuel Panselinos, of Thessalonica, we find (p. 15) that the practice of making tracings from pictures for copying purposes was common, and again (p. 17), the opening chapter of the treatise is devoted to this subject, and a method is described of taking a coloured transfer impression on paper from any kind of painting, whether on oiled paper, panel or fresco. It was sufficient to paint in the general outlines, the rest being filled in afterwards. This, at any rate, shows that the early painters of the Middle Ages had sufficient knowledge of technique to produce reversed impressions from paintings, and it seems not unlikely that the impressions on the Turin relic were produced by some method of this kind from an original positive painting. Various traditional methods of tracing pictures may be found in Mrs. Herringham's recent translation of Cenneno Cennini's "Trattato della Pittura" (1437) and in Mrs. Merrifield's collection of "Original Treatises dating from the Twelfth to the Eighteenth Centuries on the Arts of Painting." In the latter work, we also find mention of myrrh and aloes being used as ingredients in oil or spirit varnishes and lacquers, while aloes seems to have been used alone as a yellow glazing pigment analogous to our "brown pink." Caballine aloes is recommended by Leonardo da Vinci for improving the colour of verdigris or for use by itself. Should aloes be actually present in the impressions on the relic, as Dr. Vignon believes, though there is no evidence of it, the fact of its being used in the above manner may offer an explanation. In the above treatises also, there are several references to methods of painting on linen with yolk of egg, thin size and other media in such a way that the cloth would bear folding without injury to the colours or gilding, so that this objection disappears. Chiffiet (p. 198) mentions the use of a spirituous tincture of cloves and cinnamon in depicting Phillip II. of Spain in his shroud (*lintes*).

A far more important point against his theory, which has been quite overlooked by Dr. Vignon, is that the best modern authorities seem to be agreed that the "aloes" mentioned in the Bible is not to be confounded with the ordinary medicinal drug, but is the perfume known as "lign-aloes" (Hebrew, *Ahalim*), or the resinous wood of *Aquilaria Agallocha*, which grows in India and other parts of the East (Hanbury, "Scient. Papers," p. 263). The better qualities of this wood have a fine perfume when shredded, and it seems to have been used in that state mixed with myrrh and spices. It is mentioned by J. B. Porta in the *Magia Naturalis* as a perfume. Pingone, in his history of this relic ("Sindon Evangelica," p. 22), in a hymn dated 1562, alludes to myrrh and *fragrant* aloes brought from India and Arabia, the former being an essentially Arabian product. If this or a similar resinous perfume is really referred to by St. John, the only evangelist who mentions aloes, Dr. Vignon's theory at once falls to the ground, because he distinctly alludes to the drug which contains aloin and aloetin and is darkened by the action of ammonia, while, so far as I have been able to ascertain from specimens of the wood and resin of *Aquilaria Agallocha*, from Assam, ammonia produces only a very slight coloration of their tinctures or of linen soaked in them; and as either the wood or the resin would no doubt have been used in the dry state, any slight darkening of their solutions by ammonia would not affect the question of production of the images on the relic. Dr. Vignon assumes that the myrrh and aloes were mixed with olive oil, but there is nothing in the sacred records to that effect. If any such oily mixture were used, the relic could not fail to still bear traces of it and be strongly discoloured all over, regarding which nothing is said by those who have seen it, nor is it so shown in the photographs.

We now come to the "vaporographic" images, and it must be distinctly noted that while putting forward this theory as absolutely explaining and authenticating the impressions on the relic, Dr. Vignon has produced no shred of definite proof in support of it beyond the very partial success of a rough experiment with a plaster of Paris cast moistened with ammonium carbonate, and two failures, together with the opinions of certain eminent physiologists as to the possible decomposition of the excess of urea present in morbid sweats producing ammoniacal fumes, by the action of which on the aloes in the linen he claims that such impressions could have been produced in gradation according to the law of distances.

I have made several experiments on the lines indicated by Dr. Vignon with moulded figures made of flour paste and gelatine mixed with dilute solution of ammonia, so as to act on fine linen cloths soaked in various preparations of Barbadoes, or, by preference, Socotrine aloes, but in no case have I been able to obtain the semblance of a clearly *shaded* image, of parts close to the cloth or within the limit of distance of 1 cm. given by Dr. Vignon. There has always been diffusion, as must necessarily occur by the accumulation of vapour under the cloth, and an entire absence of any delineation, though in some cases there has been an increased darkening of the cloth immediately above the highest parts of the object. If this is the case with dilute ammonia, it is not likely to be otherwise with any product of the decomposition of urea from morbid secretions, but this is a question for pathologists. The most sensitive surface tried was prepared with a mixture of myrrh and Socotrine aloes rubbed up with cedar-wood oil—the latter substance being sometimes used in funeral ceremonies in the East. On one cloth prepared in this way, there is just an indication of a face, which was very roughly moulded in flour paste mixed with ammonia, and a certain amount of vaporographic action, but with no gradation or detail as is shown in the photographs of the relic.

So far as my experiments have gone, I feel almost convinced that if a body were *wrapped* or *wound* in a linen cloth, under the conditions stated in all the Gospels, it would be absolutely impossible for such a detailed impression as that shown on the relic to be produced in the manner suggested by Dr. Vignon, even supposing that medicinal aloes were used, as they sometimes were, like colocynth among the Egyptians, as a preventive against vermin. Bearing in mind, however, the bad record of the relic, remarkable as it is as a work of art, and the fact that it is not considered authentic by the authorities most qualified to judge, any further discussion of Dr. Vignon's theory seems of little importance apart from the possibility of "vaporographic portraits" being produced in the manner he has indicated, but by no means substantiated.

It is, I think, greatly to be regretted that Dr. Vignon should have brought forward his theory with such an array of quasi-scientific authority and argument based on so very slender a foundation. J. WATERHOUSE, Maj.-General I.A.

January 23.

THE accompanying outline is a reduced photographic reproduction of my tracing from Signor Secondo Pia's positive photograph of the Holy Shroud, as referred to by Prof. Meldola (NATURE, pp. 241–243), and a glance at it is sufficient to show that the original is an inferior (much faded) mediæval

painting. The proportions are such as one sees in figures in certain stained-glass windows and in mediæval illuminations; observe the plane of the elbows and the strange disproportion in the entire arms. One can hardly imagine normal upper and lower arm bones fitting into the ill-drawn shapes into which I have sketched the bones. The radius and ulna of both arms, instead of being much shorter than the humerus, would, if inserted, be longer. If the left humerus of the figure is assumed to be correct in length as shown from A to B in my added black line, then the true length of the ulna should only reach from B to C, and not be half as long again as in the painting. On the other hand, if the length of the right ulna is considered correct as from D to E in my added black line, then the humerus would, in nature, reach from E to F—assuming the relative proportions of humerus and ulna to be 13 and 10½. It is quite within the bounds of possibility to name the painter of this strange figure.

The fold of the shroud is just over the top of the head, yet the painter was so incompetent to deceive that he made the two head-tops touch, like two hemispheres—as shown in the outline—whereas if the material had been folded over a head, a space of 6 inches would have been necessary for covering the neighbourhood of the junction of the coronal with the saggital suture. As painted, the shroud appears to have been folded over a piece of flat pasteboard.

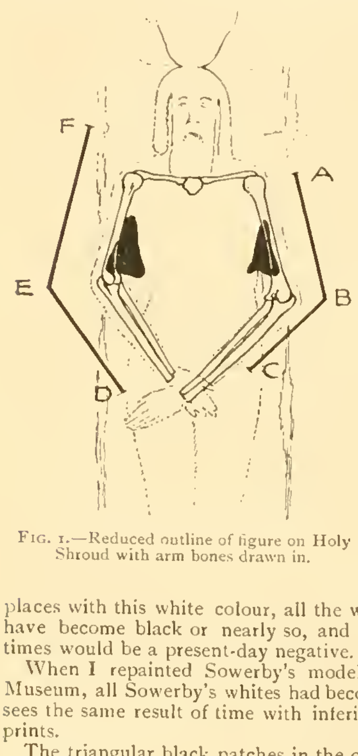

FIG. 1.—Reduced outline of figure on Holy Shroud with arm bones drawn in.

As for an artist—especially a mediæval one—being able to paint a picture in imitation of a negative, as suggested by Prof. Meldola, I have never heard of such a work, but if the painter of this picture had used an inferior white pigment as a body colour, as one of the compounds of carbonate or hydrate of lead, and heightened the light places with this white colour, all the whites by this time would have become black or nearly so, and the positive of mediæval times would be a present-day negative.

When I repainted Sowerby's models of fungi in the British Museum, all Sowerby's whites had become a leaden-black. One sees the same result of time with inferior whites in old coloured prints.

The triangular black patches in the outline are damages upon the shroud. WORTHINGTON G. SMITH.

Dunstable.

The Theory of Laughter.

PROF. SULLY has given us in his latest work a model monograph on laughter.[1] With much charm and penetration, and in the light of a wide knowledge of the very extensive literature of the subject, he discusses the nature, causes and effects of laughter, its uses, its origin, its development and its future in the race and in the individual. He criticises the more important of the many theories of the ludicrous propounded by philosophers in all ages; he shows that each one of them fails to account for a considerable proportion of the many varieties of the ludicrous, and he concludes "that the impressions of the laughable cannot be reduced to one or two principles." While thus recognising the impossibility of bringing all kinds of laughter-causing things under one formula, Prof. Sully points to two causes of laughter which are closely allied and frequently cooperate, namely a sudden oncoming of gladness and a sudden release from constraint, and these he regards as the two principles most generally applicable to the explanation of the nature of the ludicrous. There is implied here and throughout the book the assumption that "the laugh . . . is in general an expression of a pleasurable state of feeling," an assumption which finds also explicit expression in several passages, *e.g.* "that outburst of gladness which we call laughter" and "laughter being primarily the expression of the fuller measure of the happy or gladsome state." It is assumed, in fact, that that which makes us laugh does so in general in virtue of its pleasing us, or, more shortly, that in general we laugh because we are pleased.

This assumption, which is implied in several of the older theories of the ludicrous, seems to be regarded as self-evident and in need of no justification, and yet it logically leads to some strange and startling conclusions. Thus we are led to infer that to a normal human being the sight of a man on crutches gladdens the eye (p. 89), that there exists a general tendency "to rejoice in the sight of what is degraded, base or contemptible" (p. 89), that very laughable and therefore, according to this theory, very pleasing things are exhibitions of vanity, hypocrisy, lying and deceit. Prof. Sully makes out the following list of twelve classes of laughable things, *i.e.* things the spectacle of which provokes laughter:—(1) Novelties, (2) physical deformities, (3) moral deformities and vices, (4) disorderliness, (5) small misfortunes, (6) indecencies, (7) pretences, (8) want of knowledge and skill, (9) the incongruous and absurd, (10) word-plays, (11) that which is the expression of a merry mood, (12) the outwitting or getting the better of a person. We may perhaps strike out from this list the eleventh class, because it cannot properly be said that we laugh *at* that which is the expression of a merry mood; we should rather say that it excites our laughter through the force of sympathy and imitation. And we may perhaps emend the definition of the twelfth class and say that what we laugh at is the spectacle of the man being outwitted or got the better of. Laughable things, then, fall into eleven classes, each one of which is for most men highly displeasing when the specific character of the class is strongly marked, but provokes laughter in most of us, when in certain moods, if its specific character is but slightly marked, though to many men (the agelasts) the spectacle of any one of these things (with the possible exception of those of the first class) is at all times and in all degrees displeasing. And, in fact, well-nigh every instance of the ludicrous mentioned in the book is essentially displeasing in character, and even the laughter of the refined individual laugher, the humorist, is said to be fed on "the spectacle of folly, of make-believe and of self-inflation." Surely an unpleasing diet! It is significant, too, that laughter is not infrequently provoked by the sudden announcement of a death or by the description of some extremely horrible experience or series of events, as also by a severe blow on the shin, on the "funny-bone" or on other parts of the body, and by situations that excite an unpleasant state of "nerves" or "needle."

If, then, we rid ourselves of the assumption that laughter is the expression of pleasure, we shall admit that, while on the one hand the noble, the beautiful, the harmonious, the orderly and the sublime are pleasing but not laughable, on the other hand the mean, the ugly, the incongruous, the riotous and the ridiculous are displeasing, although in certain circumstances they may provoke laughter; we shall admit, in short, that the laughable or the ludicrous is essentially displeasing, apart from the laughter that it may provoke. We may put alongside this conclusion two other indisputable facts of great significance; firstly, the fact that laughter, if not excessive, produces beneficial physiological effects of an exhilarating nature, it produces "accelerated circulation and more complete oxygenation of the blood" and "a considerable increase of vital activity by way of heightened nervous stimulation"; secondly, the fact that laughter causes "a *dispersion* of the energies which for the maintenance of the attention ought to be concentrated. We are never less attentive during our waking life than at the moment of laughter."

We have, then, these three facts:—(1) The things we laugh at are in themselves displeasing, (2) laughter disperses our attention, (3) laughter produces a general increase of the vital activities. When thus brought together, these facts irresistibly suggest that we, being but imperfectly adapted to the world in which we live and therefore necessarily surrounded by the depressing spectacle of suffering, of disorder and of incongruities, and *sympathy* being inwrought in the very bases of our constitution, have been endowed by beneficent Nature with the

[1] "An Essay on Laughter." James Sully, M.A., LL.D. Pp. xvi+441. (London: Longmans, Green and Co., 1902.) Price 12*s.* 6*d.* net.

impulse to laugh at what is displeasing and painful in order that the automatically determined movements of laughter may disperse our attention, may prevent us attending to the displeasing spectacle and, by their stimulating effects, may counteract its depressing influence.

These facts suggest, in short, a theory of the ludicrous the exact converse of that which we may call the pleasure-theory; they suggest that we laugh at the ludicrous, not because it is pleasing, but because it is painful.

Such a theory may appear at first sight somewhat paradoxical, and yet as an explanatory principle it may perhaps go further and deeper than any other. The truth of it appears clearly in those cases in which we begin by disliking a thing and proceed to ridicule it, *i.e.* to display it in its ludicrous aspects. Prof. Sully appears as an apologist and advocate of laughter, and yet even he recognises that laughter is not all joy, as when he says of modern laughter "there is in it from the first ejaculation something of a biting sensation or something of a melancholy pain," and again, "the laughable spectacle commonly shows us in the background something regrettable"; and of its function as a vitaliser or stimulant that enables us to bear up against the ills that surround us he has no doubt. "Some hearts of many chords . . . might break but for the timely comings of the laughter-fay with her transforming wand."

In considering any theory of the ludicrous, we must sharply distinguish between "laughter-at" and that simplest, most charming and infectious kind of laughter which is the overflow of good spirits and is fully explained by Herbert Spencer's principle of the overflow of surplus nervous energy into the most open tracks. "Laughter-at" is, of course, often combined with other forms of laughter, and the accompanying mental state may be extremely complex, yet the spectacle of the displeasing seems to be its fundamental cause.

Just as in times and places in which the mass of men live under unnatural and depressing conditions the stimulating effects of alcohol are used not merely as a protection against cold, but are sought for their own sake, so the spectacle of the coarse and brutal comes to be sought for the sake of the stimulating effects of laughter, normally a protection against depressing mental influences; we have then the curious phenomenon of the crowd flocking to the circus and the pantomime (to have a good laugh, as they frequently say), where the staple source of laughter is the buffeting of the clowns, blows being apparently dealt which, if witnessed in real life, would make one-half the spectators feel sick and faint. We may note, too, how in the course of a football match a heavy fall or a violent collision between the players calls forth a roar of laughter from the crowd and so adds to the attractions of the spectacle.

The consideration of the laughter caused by tickling also points away from the "pleasure-theory" and supports the theory here suggested. There can be little doubt that the sensation of tickling is in itself distinctly unpleasant, both to the child and to the adult, even while the victim responds with loud laughter; the enjoyment of the situation by the child seems to be analogous to its enjoyment in being mildly frightened or in any other vivid and lively experience. And Prof. Sully himself tells us that "much, at least, of the later and more refined laughter is analogous to the effect of tickling."

It may seem at first sight that the view proposed is merely an application of, and involves the acceptance of, the Lange-James theory of the emotions, and that Prof Sully has dealt with it in those pages in which he very properly rejects that theory: but this is by no means the case, for laughter is not an emotion, but a state of the physical organism (producing certain effects in consciousness) that may accompany almost any emotional state. If we accept the view here suggested, we may surmise that the laughter reaction has been developed as a necessary corrective of the effects of sympathy, for the power of sympathy is so great that in the absence of this corrective those spectacles, which meet us on every hand and which we call the ludicrous, might well destroy us.

In making this suggestion, it is not intended to deny the plurality of causes in most cases of "laughter-at," for, though the principle suggested may indicate the predominating factor in the case of the coarse laughter of low minds, in highly developed minds it becomes so overlaid with complicating factors as to be with difficulty distinguishable in many cases. If the principle suggested be regarded as inadmissible, the violence of the laughter-reaction must remain something of a mystery, for it is altogether disproportionate to the causes that are assigned to it. The acceptance of this theory would in no wise invalidate those theories of the social functions of laughter developed by Prof. Sully in a most interesting manner, but would rather strengthen them, because it would make clear the cause of the universal dislike to being laughed at, a point which for the pleasure-theory of laughter remains obscure.

W. McDougall.

Insects and Petal-less Flowers.

Prof. Plateau, of the University of Ghent, has for many years carried on a series of important experiments concerning the ways of insects in visiting flowers. He contends that they are not attracted by the brilliant colours of the blossoms, but rather by the perception in some other way—probably by scent—that there is honey or pollen.

I have just received from Prof. Plateau an account of some of his most recent work, and it seems of sufficient interest and importance to lay before the readers of Nature. His paper, "Les Pavots décorollés et les insectes Visiteurs," is a record of experiments carried on during 1901 and 1902 and published in the *Bulletins de l'Académie royale de Belgique*, November, 1902.

Flowers of *Papaver Orientale*, L., were deprived of their petals, and the number of insects visiting the remaining parts carefully noted and compared with the number of those visiting neighbouring intact flowers.

Now it seems evident that the question, Are insects attracted by the brilliant colours of flowers? should be decisively answered by such experiments. If they are thus attracted, then we should expect them to neglect these petal-less flowers while visiting the others. In removing the petals, Prof. Plateau took certain precautions. The unopened flower was carefully enclosed in a sort of cage, so as to preclude insect visits. When it expanded, the petals were carefully removed by means of a pair of scissors kept specially for this purpose. Great care was taken to avoid touching any of the remaining parts of the flower with the fingers. Prof. Plateau lays special stress on this, as he thinks that certain previous experiments of a similar nature have been vitiated by neglecting such a precaution. The experimenter in removing the corolla has left on the remaining parts the scent of human fingers. Its keen sense of smell enabling the insect to perceive this, it has consequently avoided the flower.

The poppy flowers thus carefully prepared were watched, and the number and kind of insects visiting them noted. At the same time, a number of intact flowers were similarly watched. Here are the results as summed up by Prof. Plateau:—

In the 30 petal-less flowers.	No. of visits.	In the 70 normal flowers.	No. of visits.
Apis mellifica ...	97	... ...	121
Megachile centuncularis	1	... ...	1
Osmia aurulenta ...	0	... ...	1
Halictus sexnotatus	19	... ...	18
Oxybelus uniglumis	14	... ...	29
Small unidentified Hymenoptera	0	... ...	1
Melanostoma mellina ...	4	... ...	0
Syrphus corollae ...	1	... ...	0
Telephorus lividus ...	1	... ...	1
Total	137		172

Or taking the average, each of the 30 petal-less flowers received 4·5 visits, each of the 70 normal flowers received 2·4 visits.

So great, indeed, appeared to be the attraction of these petal-less flowers that on many occasions Prof. Plateau has seen more than one bee in a single flower. Here are his figures on this point:—

	Times.
2 hive bees in same flower	9
3 ,, ,, ...	2
1 hive bee and 1 Halictus	2
2 hive bees and 1 Halictus	1
1 Halictus and 1 Oxybelus	1
2 Oxybelus	1

Insect visits to flowers which have naturally lost their petals are by no means uncommon. Darwin noted them in certain flowers. I have myself seen bees visiting flowers of *Geranium phaeum*, *Helianthemum vulgare*, *Rubus fruticosus* and *Salvia officinalis* which had lost their petals.

13 Vicarage Drive, Eastbourne. G. W. Bulman.

A ROMANCE OF THE DEEP SEA.[1]

TO those of our readers who have followed our successive notices of the great work achieved by Dr. Alcock in the exploration of the Indian Seas, for which he has just been granted a Coronation honour, the present book, dedicated by the author to his shipmates, will be welcome; while to the general public it ought to be both interesting and instructive, if only by the nature of its contents and its literary style. It is divided into three parts; the first, of fourteen chapters, giving a popular account of the ship and the voyage, and of apparatus and methods employed; the second, of nine chapters, giving a popular account of the deep-sea fauna of the Indian region; the third, in the form of appendices, being a list of dredging stations and depths, and a complete record of the literature of the expedition as thus far published. The Andaman and Arabian Seas, and the Bay of Bengal, were the scene of action; and, in the intervals of dredging and surveying, land parties were daily put ashore to sound and erect survey marks, and were in some cases left there for a month at a time for tide-watching, shore-collecting and other congenial occupations. Among the islands visited were the Andamans (twice), the Laccadives and the Coco set. To Cardamum and Minhikoy a special chapter is given.

FIG. 1.—*Chlaenopagurus Andersoni*, with its protective blanket of sea anemones. (From Alcock's "Naturalist in the Indian Seas.")

[1] "A Naturalist in the Indian Seas; or, Four Years with the Royal Indian Marine Survey Ship *Investigator*." By A. Alcock, M.B., LL.D., F.R.S. Pp. xxiv + 318; 98 figs., tables and a map. (London: J. Murray, 1902.)

The author pays a just tribute to the pioneer work of Davis and Baffin, to Drake, as the discoverer of the "Robber crab," and to the early labours of the Bombay Marine in 1832 and of the Marine Survey of India in 1874, which, under the stimulus arising out of the *Challenger* expedition, led to the adoption of modern standards and the now memorable series of voyages which will ever be associated with the author's name.

The earlier portion of the book, intentionally popular, is charming in its method. A walk across the bed of the ocean from Madras to the Andamans is idealised in a manner calculated to fascinate the reader and arouse an interest in marine research. The Globigerina ooze, depth and darkness, the essentials of coral reef structure and formation, and other allied topics, are graphically introduced, in terms as far as possible expressive of the author's first impressions and his enthusiasm thereby aroused.

Adaptation to life in deep water and colour variation and resemblance come conspicuously into consideration; and interesting to a degree are the descriptions of a series of hermit crabs, some so little modified as to remain lobster-like in appearance, but still given to the characteristic hiding habit. One of these creatures, from the Andamans at 185 fathoms, "bottles" itself in a piece of mangrove stem or a bamboo internode, filling it tightly, with its great claws so extended that their terminal joints, flexed, close the mouth of the tube as by a lid. Another (Chlænopagurus) from the Malabar coast effects the early attachment to its body of a compound anemone, which, extending with the growth of its host, forms a fleshy pallium bearing two lateral series of polyps. Holding the edge of this with its smaller pincers, the crab not only keeps it in place, but is enabled, as Dr. A. R. S. Anderson (who in the later days of the *Investigator* work dredged these two remarkable animals) has observed, to pull the pallium forwards the more completely to effect a covering for its head.

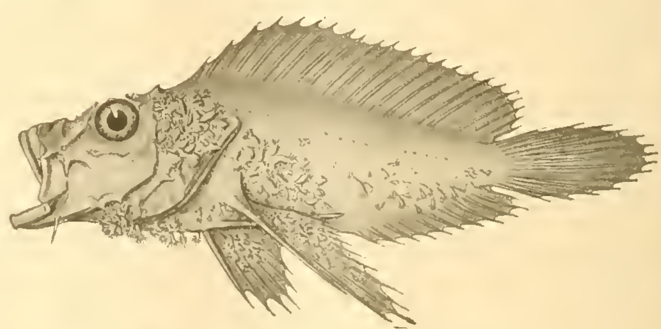

FIG. 2.—*Minous inermis*, with commensal polyps (*Stylactis minoi*). (From Alcock's "Naturalist in the Indian Seas.")

The work teems with charming topics of this order. Croaking crabs, milk-giving rays, luminous fishes and crustaceans are described, the latter as discharging a renal (green-gland) and para-oviducal secretion, and a sea-urchin has been observed which carried rice to its burrow for storage. Among the deep-sea fishes, of

which some 169 species are recorded, the voracious habit of swallowing a prey several times its own size is extended to a powerfully dentigerous Scopeloid Odontostomus, living at 573–870 fathoms.

Most interesting among the fishes is a Scorpænoid (*Minous inermis*), trawled at 45–70 fathoms both N. and S. of the Bay of Bengal and in the Malabar Sea. It has a compound Hydroid (*Stylactis minoi*) living commensally about its branchial region, and of this creature we recall the fact that, in his original memoir upon it, the author tells us how, in the presence of two species of the genus Minous, it will select that after which he has now named it.

Numerous other fantasies are attractive features of the book, as, for example, certain stories of bird-life which have come within the experience of the author and his wife, which almost baffle comprehension. And as a noteworthy scientific fact, the author tells us that while his greatest haul was one at 188 fathoms in the Andaman Sea near the Cinque Islands, his successor, Dr. Anderson, obtained nothing on repeating it.

For those who love sensation and admire pluck, the story of the carrying away by a big shark of a drift-net, which with its sinkers weighed more than 450 lb., the two becoming involved "past all surgery," like that of the fate of the cork of a bottle of "Bass" when lowered to 439 fathoms, where the pressure is equal to two tons to the square inch, and, above all, of the loss of the cap of one of the lieutenants, while returning to the ship after the successful rescue of a gunner from the attentions of three man-eating sharks, are tales of the sea as instructive as they are exhilarating, which must be read to be appreciated.

Among the more important discoveries of the voyage emphasised in the book are those of a "solitary" coral (*Caryophyllia ambrosia*), and the giant ostracod Bathynomus and blind lobster *Phoberus caecus*, hitherto thought to be characteristic of the depths of the Gulf of Mexico; and there are endless other records little less important than these, as all familiar with Dr. Alcock's scientific memoirs may well imagine. The book is interesting and attractive from cover to cover, worthy its author's reputation as a naturalist and explorer; and we know of no popular work of the kind more trustworthy and at the same time better calculated to give the reader an insight into the nature and methods of marine investigation, and to arouse an interest in this charming pursuit and the quaint resources of the deep sea. It is one of the best natural history books published for some time, altogether admirable, and it cannot fail to be widely read and appreciated.

A TRAVELLER IN PATAGONIA.[1]

HUDSON, in his "Idle Days in Patagonia," says "It is not strange that the sweetest moment in any life, pleasant or dreary, should be when nature draws nearer to it, and, taking up her neglected instrument, plays a fragment of some ancient melody, long unheard on the earth." Perhaps in Patagonia, more than in any other part of the western continent, the traveller feels the touch of *aeons* of forgotten centuries. He finds himself in a strange, unfinished world. On the west, a belt of volcanic peaks, snow-crested and glacier-dotted, represents the last fiery effort of the Andes to divide the world into two fractions. Cradled in their ramifications lies an extensive system of great lakes of surpassing beauty—lake succeeding lake for a distance of 600 miles from north to south. On all sides are found ancient moraines and the remains of mountains which have been torn to fragments by volcanic action, and vast cañons and deep river beds through which streams have sometimes found their way to the Atlantic and then again to the Pacific Ocean, or *vice versâ*, according to the convulsions of nature. Between the Atlantic coast and this Andean belt rises terrace after terrace, representing one of the greatest Tertiary deposits known. The shingle- and basalt-covered plains are scored by violent rivers and deep, broad depressions. Everywhere are found evidences that the country has been several times submerged and raised. The plains are the home of the guanaco, the huemul, the puma, the American ostrich and countless varieties of the feathered tribe. Primitive man must have found here a rare hunting-ground. His numerous, sturdy descendants, a nomadic hunting race, without trace of agricultural life, presented a bold front to the Spanish *conquistador*. They had several tribal divisions; the Moluches, or warriors (called Araucanos by the Spaniards), occupied both sides of the Cordillera in Patagonia, and were subdivided into Pehuenches and Huilliches. The former extended to 35° south lat. and derived their name from *pehuen*, a pine tree, and *che*, meaning people. The Huilliches, or southern Moluches, had four subdivisions, and extended along the whole west side of Patagonia south to the Straits of Magellan. The Puelches, or eastern people, so-called by the Moluches, occupied the whole of Patagonia between the Atlantic Ocean and the Andes, but were split into several fractions; the most southern one was known as the Tehuelhets, but called themselves Tehuel-kunny, or southern men, generally known in early writings as Patagones, but in modern times writers have fallen into the error of calling them Tehuel-ches, applying the Araucano *che* instead of the Tehuel *het* to denote people.

All these tribes south of 36° south lat. were the scourge of the Viceroyalty of Buenos Ayres and incessantly raided the Spanish settlements as far north as the line of the present Central Argentine Railway, even as late as 1868. In 1845, they proposed to the Government of Buenos Ayres that the southern frontier of the province should be the River Salado, only eighty miles south of the city of Buenos Ayres. There is now but a remnant of them left.

Such is the country the interior of which Mr. Prichard traversed from the mouth of the River Chubut to Puerto Gallegos, covering about nine degrees of latitude, and such the "Tehuelches," the only indigenous tribe whom he met, from time to time, *en route*. His expedition was generously financed by Mr. Pearson, proprietor of the *Daily Express*, of London, with the hope of discovering a living specimen of the Giant Ground Sloth—the prehistoric Mylodon—a portion of the remains of one having been previously found, at Last Hope Inlet, by the well-known Argentine *savant*, Dr. F. P. Moreno. In his quest, Mr. Prichard was unsuccessful; and it recalls to mind that a King of Spain was also unable to obtain a live Megatherium which he had ordered a Buenos Ayrean Viceroy to obtain and send to him. But if Mr. Prichard could not bring a Mylodon to life, he has at least given a life colouring to Patagonia in his charming book. It is profusely and richly illustrated from photographs and maps drawn from the inexhaustible collection made by Dr. Moreno during his years of explorations there. After devoting a few interesting pages to the physical features of Patagonia, its discovery, and some mention of some of the travellers and writers who preceded him, Mr. Prichard takes us with him to the Welsh Patagonian settlement, at the mouth of the River Chubut, and tells us that "the older and younger generation are unlike each other now, and will probably continue to become more so as time goes on. Physically, the younger people are far better developed than their elders." The splendid climate is evidently destined to grow a superb race of men—such, in fact, as Pigafetta and others, of Magellan and Drake's

[1] "Through the Heart of Patagonia." By H. Hesketh Prichard. (London: William Heinemann, 1902.)

time, found round the margin of the country. Mr. Prichard says: "Although not giants, the Tehuelches are certainly one of the finest races in the world. Most of them average six feet, some attain to six feet four inches, or even more; and in all cases they are well built and well developed." . . . "Progress, the white man's shibboleth, has no meaning for the Patagonian. He is losing ground day by day in the wild, onward rush of mankind. Our ideas do not appeal to him. He has neither part nor lot in the feverish desires and ambitions that move us so strongly. As his forefathers were, so is he—content to live and die a human item with a moving home. . . . He is far too single-minded and too dignified to stoop to a cheap imitation."

Like many other travellers, Mr. Prichard appears to have initiated his explorations with much impedimenta, the care of which, for weeks, entailed a life of misery—eight men, sixty horses, two wagons with luxuries, and "drafts on Cook and Son" (not easily cashed at a Tehuelche bank) might have provoked some criticism from the army which San Martin marched across the Andes. But our author, be it said to his credit, soon redeemed himself and put his expedition into light marching order. In time, he might have got down to gaucho methods of travel, five horses to a man, a herd of horned cattle for food and nothing more, for months together.

FIG. 1.—Cañadon of the River Katarina. (From Prichard's "Through the Heart of Patagonia.")

A sportsman's veins must throb as he reads Mr. Prichard's volume, for it is one long tale of hunting exploits; but one must applaud the author for killing for food alone, and not for gratification of the love of slaughter. Of large game, the guanaco proved to be most abundant, but bird life was myriad. Altitude seems to make no difference to that representative of the camel species, the guanaco; he thrives equally at sea-level and, in great herds, at an elevation of from 10,000 to 13,000 feet among the Bolivian and Peruvian Andes, almost rivalling the condor in this respect.

Here and there, the author makes an interesting remark upon the effect of his surroundings on the mind: "The farther you penetrate into Patagonia, the more its vast emptiness weighs on you and overwhelms you. . . . Out there, in the heart of the country, you seem to stand alone with nothing nearer or more palpable than the wind, the fierce mirages and the limitless distances. A man accustomed to cities would here feel forlorn indeed. . . . Nature, with her large, loose grasp, enfolds you. There is no possibility of being mentally propped up by one's fellow man."

On reaching Lake Buenos Ayres, he found it "measured seventy-five miles in length; vast masses of milk-white timber, blanched by the influences of sun and water, and eloquent of the mountain land and forest whence they have been washed down, lie at the lip of the flood-level. . . . Around the lake lay piled the skulls and bones of dead game, guanaco and a few huemuels."

"There are many thousands of square miles of unexplored forest in Patagonia. It is a region unknown and mysterious, which has never been deeply penetrated by man owing to the practical absence of game on which he might subsist."

Mr. Prichard's book is replete with interest, and shows that he put himself into close touch with the region which he examined. His final chapter treats of the future of Patagonia, a large portion of which he believes suited to pastoral purposes. It is evident that the emigrant will soon destroy the varied and beautiful forms of animal life which nature has placed there, and substitute for them horses, sheep and other cattle—then Patagonia will be civilised.

G. E. CHURCH.

THE GEOGRAPHY OF NORTH-WEST EUROPE.[1]

IN this second volume on Europe in the new issue of Stanford's "Compendium," the chief place is given to the British Isles. Chapters on Belgium, the Netherlands, the Grand Duchy of Luxemburg, Scandinavia, Denmark and Iceland occupy about a quarter of the volume, and contain descriptions of the physical features of these countries, with brief references to the geology, and accounts of the climate, the agricultural, mining and other industries, the ethnology, and of the changes introduced by man, notably in the Netherlands. These subjects are necessarily dealt with far less fully than in the case of the British Isles.

The chief aim of the work is to show "how geographical conditions have affected the course of history." Hence it is needful to gather the lessons which geology teaches, and in dealing with our country the author

[1] "Stanford's Compendium of Geography and Travel" (new issue)—Europe. Vol. ii. The North-west. By G. G. Chisholm, M.A. Pp. xxviii + 742. (London: Edward Stanford, 1902.) Price 15s.

enters rather fully into the main geological and topographic features, and if his account is somewhat rambling, it has evidently been prepared with pains. Thus we learn how the geological formations have influenced the physical features, the mineral wealth and the soils, and have determined the development of industries and of population.

The reader, however, must be warned not to take everything he reads as sound geological doctrine. Thus (on p. 75), "It is estimated that in comparatively recent (post-Miocene) times the higher peaks of Britain were about 3000 feet higher than they are now above the present sea-level, and as the sea-level of these times relatively to this portion of the land was 3000 feet lower than it is now, the absolute elevation of those higher peaks must then have been about 9000–10,000 feet." There are probably few geologists who would support this statement.

Moreover (on p. 81), it is not right to say that in the lake district "the ancient stratified rocks of Cambrian or Silurian age" are extensively covered with volcanic deposits, the fact being that the Skiddaw slates are overlain by the Volcanic series of Borrowdale, which is an important member of the Lower Silurian or Ordovician system.

On p. 98, we read that the chalk with flints is for the most part "a lower zone than the chalk without flints," whereas the reverse is usually the case. The same remark applies to a paragraph on p. 116, wherein it is stated that "the difficulty of obtaining water retarded the spread of London northwards over the London Clay and Boulder-clay in the direction of Islington, Highbury, &c., until water was conveyed there by pipes, while sands and gravels in the north-west allowed of an early extension of the suburbs towards Hampstead."

As a matter of fact, Islington is on gravel, and although the old village of Hampstead is on Bagshot Sand, which locally yields springs, the large area of London Clay north and north-west of the Marylebone Road was long thinly populated in the districts now known as Camden Town, Kentish Town, St. John's Wood and Kilburn. In Middlesex, the Boulder-clay does not occur south of Finchley.

After the general geological account of England and Wales, a chapter of twenty pages is given to the volcanic phenomena of the British Isles, based on Sir Archibald Geikie's "Ancient Volcanoes of Great Britain," as duly acknowledged. Interesting as this subject is, it appears hardly to require separate treatment in a work intended as a "Compendium of Geography and Travel." Curiously enough, no mention is made of the Cuillin Hills of Skye, the roughest mountain group in Britain, and one which especially tempts the rock-climber.

We pass on to chapters having special reference to England and Wales, and dealing with the climate, rivers and lakes, and the inhabitants from Palæolithic times to the present day. There is only a brief reference to modern views on the origin of rivers, but we find much interesting matter of all sorts, with statistics where needful and references to authorities.

English agriculture, with an account of the open field system, mining and smelting, manufactures and commerce, and the political situation from "Domesday to 1800" are dealt with in separate chapters. Consequently we are led back again to early English and Roman times when reading of land customs and lead-mining; while coal-mining, dealt with briefly in earlier chapters, is also touched on as regards its history, and again dealt with from a statistical point of view in the subsequent chapter on the nineteenth century. A certain amount of repetition can hardly be avoided. The sites of villages as dependent on geological conditions, mainly on water-supply, are discussed briefly in the geological chapters. Later on, there is a chapter devoted to the chief towns, their history and growth. Thence we pass on to local government, with which the account of England and Wales terminates. In this last chapter, it is interesting to read of the utilisation of Carrington Moss and Chat Moss for the town refuse of Manchester, and we believe that the value of the Carrington estate has been increased to the extent of 35,000*l*.

Scotland and Ireland are dealt with less fully, but the same general subjects are discussed, including Highlanders and Lowlanders, mineral products (with a mention of the many old bloomeries), Scottish agriculture, the growth of towns, &c. With reference to Ireland, there is a chapter on the Irish land question, the causes of Ireland's decay, and possibilities for the future. It is concluded that much may be done if hereditary sloth be shaken off and industrial knowledge be acquired.

Frith, photo.

Fig. 1.—Tintagel. (From Chisholm's "Europe.")

British dependencies in Europe, including the Isle of Man, the Channel Islands and Malta, are disposed of in five pages. The Orkney and Shetland Isles, though not mentioned in the index, are briefly referred to. St. Kilda is not noted. The index is not all that could be desired. Thus, no reference is given to coal, chalk, geology or Old Red Sandstone, while Weybourn Crag and Wadhurst Clay are indexed.

Despite the few criticisms we have ventured to make, we can commend the work as containing a very large amount of useful and interesting information, pleasantly written, on what may be termed the geographical history of north-western Europe, and of the British Islands in particular.

It is well printed, and illustrated with two geological

and fourteen other maps. There are also eighty-six text illustrations, mostly of towns and of striking physical features. By the courtesy of the publishers, we are enabled to give one of the illustrations.

BRITISH FORESTRY.

THE recommendations in the report which has just been issued by the committee appointed by the President of the Board of Agriculture "to inquire into and report upon British forestry" follow very much the trend of the opinions that have in recent years been expressed in NATURE and elsewhere. As was expected from the terms of the reference to the committee—"to consider whether any measures might with advantage be taken, either by the provision of further educational facilities or otherwise," to improve and encourage the "position and prospects of forestry"—the report deals chiefly with the root-matter of the forestry question—education. To such an extent is this the case that other elements of the forestry problem in Britain, such as the incidence of rates, the taxes upon timber transport, inequality in the levying of estate duty and the game question, are treated as minor considerations.

The report recognises the different classes requiring education in the country—landlords, land-agents and wood-foresters. In the forefront of the recommendations, the committee places the acquisition by the State of "two areas for practical demonstration," "one in England and the other in Scotland, of not less than 2000 acres, if possible, nor over 10,000 acres in each case," to furnish an object-lesson and to serve as areas of instruction for working foresters. They also recommend that forestry should be a subject of instruction at Oxford and Cambridge as it is at Edinburgh, and that example-plots of 100-200 acres in extent should be formed in the vicinity of these universities for the illustration of forestry teaching, and in this connection they also express the opinion that the forestry department of Coopers Hill should be transferred to a university centre. Forestry should also, they recommend, be a subject of study in the curricula of all agricultural colleges, and the teaching of forestry by county councils is recommended.

The whole tenour of the report is sound, although timidity and want of grasp might be indicated in several places, and it is satisfactory that the President of the Board of Agriculture has now in his hands a statement showing the main lines upon which, in the opinion of those who have given their attention to the subject, the forestry of this country may be improved. It remains to be seen whether any action will follow upon the report.

NOTES.

IT is with deep regret that we announce the death of Sir George Gabriel Stokes, Bart., F.R.S., at Cambridge on Sunday last, at eighty-three years of age. By direction of the president, the ordinary meeting of the Royal Society announced for to-day will, out of respect for his memory, not be held. We believe that representatives of all the scientific organisations with which Sir George Stokes was connected will attend he funeral at Cambridge to-day.

WE regret to see the announcement of the death of the Rev. Norman Macleod Ferrers, F.R.S., master of Gonville and Caius College, Cambridge, in his seventy-fourth year. Dr. Ferrers graduated in 1851 as senior wrangler and Smith's prizeman. He was the author of several mathematical treatises, including one on trilinear coordinates and another on spherical harmonics. He was appointed master of his college in 1880, and was elected a fellow of the Royal Society in 1877.

IT is reported that the Lick Observatory has received from the Carnegie Institution a grant of 800*l*.

THE annual meetings of the Institution of Naval Architects will be held on Wednesday, April 1, and the two following days at the Society of Arts, London, W.C. The Earl of Glasgow, president, will occupy the chair.

MR. HENRY PHIPPS, who is now travelling in India, has given Lord Curzon the sum of 2000*l*. to be devoted to an object of practical benefit or scientific research promising to be of enduring good to India.

THE *Times* correspondent at Rome states that on January 30 the Chamber of Deputies unanimously passed a vote of congratulation and thanks to Mr. Marconi for the great services he had rendered to the world and the glory he had won for his country, Italy.

THE annual meeting of the Society for the Protection of Birds will be held on Tuesday, February 10, at the Westminster Palace Hotel, Victoria Street, London, S.W. The chair will be taken at 3 p.m. by His Grace the Duke of Bedford, K.G.

IT was hoped that Gilbert White's house, "The Wakes," at Selborne, Hants, and the grounds of thirty acres, would be secured by the nation as a memorial to the famous naturalist. Announcement has, however, just been made that the property has been purchased by Mr. Andrew Pears.

THE International Congress of Historical Science will be held in Rome on April 2 9, 1903. Among the eight sections is one of history of the mathematical, physical, natural and medical sciences. Communications should be addressed to the secretary, Via del Collegio Romano, 26, Rome.

THE great electric generating plant at Niagara Falls was destroyed by fire on the night of January 30. The correspondent of the *Standard* says the fire was caused by lightning, which struck a cable with defective insulation. The short circuit thus caused resulted in the explosion of one of the big transformers in the electric power-house operated by the Falls.

ACCORDING to a Reuter message from St. Petersburg, the total number of deaths caused by the earthquake at Andijan on December 16 last was 10,000. Nearly every day, subterranean tremblings of varying intensity are still felt at Andijan; on January 19 and 20 there were violent shocks, and at Uzgent, some ninety kilometres to the east of Andijan, cracks appeared in the walls of the houses.

DR. HENRY WOODWARD, F.R.S., has been re-elected president of the Royal Microscopical Society. Two visits of members of the Society to the Natural History Museum, South Kensington, have been arranged. The first will be on February 14 at 2 p.m., and the party will be conducted by Dr. H. Woodward; the second visit will take place on March 14, when Mr. W. Carruthers, F.R.S., will act as conductor.

A REUTER message from Bologna announces that Prof. Tizzoni, who recently presented to the Royal Academy of Science a report containing the results obtained from the use of a serum which he has discovered for the cure of pneumonia, states that his discovery is, so far, of purely scientific interest. Prof. Tizzoni has obtained satisfactory results from experiments with the serum on animals. Experiments have been also made with the serum in a hospital at Rome with excellent results.

PROF. SIRODOT, whose death was announced in a recent number, was professor in the Faculty of Science at Rennes for many years. Referring to his contributions to science in an

address before the Paris Academy of Sciences, M. Bornet mentioned the important work which Prof. Sirodot published on the Lemaneaceæ, Chantransia and other genera of the Florideæ. Prof. Sirodot was the first to observe the sexual organs and method of fertilisation in Lemanea, and also established the fact that some of the fresh-water species of Chantransia represent merely stages in the life-history of Batrachospermum.

THE Department of Agriculture and Technical Instruction for Ireland has taken steps to place on view for a period of three months, at the Imperial Institute, London, the extensive collection of Irish minerals and building stones which formed one of its exhibits at the recent exhibition in Cork. The exhibit will embrace samples of the varied and excellent building materials and marbles in which Ireland is particularly rich, and it is expected that the opportunity of examining these samples will be of advantage to those who are concerned in the many large building schemes now in progress in London and elsewhere in Great Britain.

THE Berlin correspondent of the *Times* reports that an influential meeting, attended by experts in fire prevention and fire brigade work from all parts of Germany, was held on Monday, February 2, to decide as to the part to be taken by Germany in the impending international fire exhibition in London. It was decided that, under the direction of an influential executive committee, a large hall should be employed exclusively as the German section. Many gentlemen present expressed their intention to attend the International Fire Prevention Congress next July.

ACCORDING to a report by the French Minister at Mexico City published in the *Moniteur Officiel du Commerce* of January 22, the mineral prospectors sent to Mexico by American capitalists have for some time been directing their efforts towards the discovery of coal deposits. The first borings have led to the discovery at El Gallo, in the district of Mazas, of coal, of which the quality is said to be excellent. The French Minister adds that his private information confirms the announcement.

THE decimal division of time has been advocated for some years by writers in several French scientific periodicals. A Geneva correspondent of the *Globe* states that a number of manufacturers in the Neufchatel canton have already taken to the manufacture of clocks and watches on the decimal system. Chambers of commerce and other trade organisations are also supporting the change. The Cantonal Commercial Chamber at Chaux-le-Fonds has issued a notice calling for models, drawings and designs for appliances and "works" applicable to the decimal adjustment of clocks and watches with the least possible departure from forms now in use.

FATHER LOUIS FROC, director of the observatory at Zi-ka-wei, informs us that since the beginning of this year the noon time-ball at the port of Shanghai has been dropped 5 minutes 56·7 seconds later than previously, so as to bring the time into connection with the international zone system. The meridian adopted is the same as that used for time in the Philippines; it is sixteen hours from the Greenwich meridian and differs from Japan time by exactly an hour. Greenwich time will also be adopted by the Great Northern Telegraph Co. along the coast of China, and it is hoped it will be gradually accepted as the standard in the other open ports.

THE *British Medical Journal* says that during the annual meeting of the American Society of Naturalists recently held at Columbia University, Washington, Prof. William H. Welch, of the Johns Hopkins University, made a preliminary announcement as to an important addition to the list of such endowments. While he was not yet prepared to make the formal public announcement, he stated that within the near future a specially endowed institute or laboratory for research in scientific medicine would be founded in the United States. The institute would, he said, be in a general way similar to the Pasteur Institute of France, and would greatly facilitate and energise special research along lines that would be of incalculable benefit to humanity.

IT is reported that Mr. John D. Rockefeller has announced his intention of spending about 1,450,000*l.* on an institution at which research will be directed towards the discovery of a cure for consumption. The plans contemplate the immediate expenditure of the sum mentioned on a medical department of the University of Chicago, following on the annexation of the Rush Medical College. They involve an elaborate scheme for a great research hospital. Mr. Rockefeller has made it known to the trustees of the University that he wishes to assist the University to evolve men who will take up original research to find cures for stubborn diseases, particularly consumption. One entire division of the new medical department will be devoted to efforts to discover a tuberculosis serum.

REFERRING to the return of Lieuts. Matissen and Koltchak, members of Baron Toll's polar expedition, and nine men of the *Zaria's* crew, the *Westminster Gazette* states that the members of the expedition passed the second winter, 1901–2, in Nerpitchiei Bay, in the island of Kotelnyi, New Siberian group, where they lost one of their number, Dr. Walter. The party did not suffer from scurvy, and the great abundance of drift-wood furnished them with material for the construction of dwellings and for fuel, while the reindeer supplied them with fresh meat. Baron Toll, who, accompanied by M. Zebert, the astronomer, left the *Zaria* to explore the interior of Bennett Island, and M. Bialznitsky, the zoologist, who had gone on an expedition to New Siberia, did not return to the ship before her departure, and were left behind. No fears are, however, entertained for their safety.

REUTER'S agency says that the secretary of McGill University College, Montreal, writing to the Press, opposes the establishment of a wireless telegraphy station on Mount Royal in the following terms:—"The physical laboratories are continuously and extensively used for teaching the curriculum of the University, the subjects taught in them being not only an essential part of the University course, but also of fundamental necessity in training men for all branches of engineering and practical science. The operation on Mount Royal of a wireless telegraphy station would seriously impair the usefulness of the physical laboratories and would prevent the University from effectively carrying on in them the work for which they were especially designed and equipped."

AT the annual banquet on January 28 of the Chamber of Commerce of Newport, Mon., Mr. Gerald Balfour, in replying to the toast of "the President of the Board of Trade," made some observations on the recent demands for a Minister and Ministry of Commerce. Referring to the great increase in the staff of the Board of Trade, he said at present the staff amounted to nearly 600, and the first cause of the great augmentation since 1786 was, of course, the immense increase in the wealth and population of the country, and its world-wide activities caused by the introduction of railways, steamships and telegraphs into the apparatus of our civilisation. Another cause was the tendency in these days to throw more duties and responsibilities upon the executive departments of the State. He thought the chambers of commerce were right when they said that, having regard to the importance of the interests of

commerce in this country, these interests should be represented by a Minister and by a department whose rank and *status* corresponded to the importance of the interests with which the Minister and department were entrusted. He was not prepared to admit, however, that a reform of the Department of State entrusted with the interests of commerce should carry with it an entire revolution in the fiscal and industrial policy pursued by this country for the last two generations.

REFERRING to Dr. Charcot's proposed north polar expedition, mentioned in last week's NATURE (p. 303), the Paris correspondent of the *Times* says that the expedition, which is under the patronage of the French Academy of Sciences and, indeed, subsidised by that learned body, will include a scientific campaign in Iceland, Spitsbergen and Novaya Zemlya. One of its chief objects is to study the habits and, in general, the biology of the codfish. In the neighbourhood of Spitsbergen, the expedition will spend some time in the investigation of those ocean currents the influence of which is so important a factor in the determination of the climate of northern Europe. At Novaya Zemlya, it is hoped to fix with more precision the limits of the islands which have thus far been insufficiently mapped out upon the marine charts. Two zoologists are to accompany the expedition, as well as a geologist and naval officers, specialists in taking astronomical and meteorological observations. It is also probable that M. de Gerlache, the head of the Belgian Antarctic expedition, will assist Dr. Charcot.

THE changes which are being made this year in the publication of *Science Abstracts* will increase the sphere of usefulness of that admirable periodical. Two separate sections will in future be published, dealing respectively with pure and applied branches of physical science. One section will embrace abstracts of papers on light, including photography; heat; sound; electricity and magnetism; chemical physics and electrochemistry; general physics; meteorology and terrestrial physics; and physical astronomy. The abstracts in the other section will refer to steam plant; gas and oil engines; automobiles; oil engine driven ships and launches; balloons and airships; general electrical engineering, including industrial electrochemistry, electric generators, motors and transformers; electrical distribution, traction and lighting; and telegraphy and telephony. The subscription prices will be eighteen shillings or four and a half dollars for each section separately, including index: for the two sections thirty shillings or seven and a half dollars. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication, and has elected Prof. E. H. Hall, of the Harvard University, as its representative on the publishing committee. In consequence of this arrangement, the physics section will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also cooperating with the committee and taking special means to bring the publication to the notice of all its members.

NEWSPAPER up-to-date science has of late undergone rapid developments, and now the buyer of a halfpenny paper expects to be regaled, not only with politics and general news, but to have laid before him in very succinct form all scientific results that are expected to have any immediate practical bearing. There is occasionally, we regret to say, an ulterior object in these abstracts, and the expert can often detect the cloven hoof of advertisement for either author or remedy, although this in many cases is ingeniously disguised. The last of this class of jotting dealt with the fact that a dog's life could be maintained for several hours after decapitation by means of the perfusion of a solution of adrenalin or suprarenal extract, and artificial respiration. The only thing new in this somewhat startling announcement is the substitution of the animal's blood by a solution containing the adrenalin. That life can continue after division of the spinal cord at its junction with the brain, and that the ordinary blood pressure can be maintained by many agents, physical and pharmacodynamic, is, of course, no new fact. Recently the power of duly oxygenated saline solutions to maintain the activity of the mammalian heart for hours has been clearly demonstrated, as indeed has also the vaso-constrictor and hence blood pressure raising power of adrenalin. Whether the alleged life restorer was the adrenalin or the saline is not clear to the public, but to the man of science the latter is more important than the former.

WE have received from Prof. F. H. Bigelow a set of reprints of his articles that have appeared in the U.S. *Monthly Weather Review* from January–July, 1902, on "Studies on the Statics and Kinematics of the Atmosphere in the United States," many of which have been previously referred to in this Journal. These reprints are seven in number, and are on the following subjects:—A new barometric system for the United States, Canada and the West Indies; method of observing and discussing the motions of the atmosphere; the observed circulation of the atmosphere in the high and low areas; review of Ferrel's and Oberbeck's theories of the local and general circulations; relations between the general circulation and the cyclones and anti-cyclones; certain mathematical formulæ useful in meteorological discussions; and, lastly, a contribution to cosmical meteorology.

THE rainfall of Madras has often been investigated as regards its relationship to the sun-spot curve, and the first indication of a probable periodicity with sun-spots was pointed out by Sir Norman Lockyer in 1872 and later by Dr. Hunter, in 1877. Both showed that the rainfall was generally greater at the times of sun-spot maxima than at those of minima. In a recent number of the United States *Monthly Weather Review* (vol. xxx. No. 9, September, 1902), Mr. M. B. Subha Rao, of the Madras Observatory, contributes an article on "The Rainfall in the City of Madras and the Frequency of Sun-spots." The author first investigates the connection between the temperature and rainfall of Madras, but comes to no very definite conclusion on this point. Dealing with the variation of the rainfall and the sun-spot curve from the year 1811, he is led to deduce that the minimum rain "occurs almost exactly on the year of minimum frequency of sun-spots, the difference being only a year in a few cases." He finds, further, that the "maximum rainfall also takes place when we have the maximum frequency of sun-spots," but he guardedly adds that the difference amounts sometimes to two or three years. Anyone who has examined the figures representing the rainfall of Madras will have noticed that there is a general trend towards an eleven-year variation; there is, however, a much shorter and more prominent period of variation, which has recently been shown (Roy. Soc. *Proc.*, vol. lxx. p. 503) to be very closely connected, not only with the variation of atmospheric pressure from year to year, but with the variation of the percentage frequency of prominences seen on the sun's limb. That this is so is strengthened by the fact of the great similarity, on the whole, of curves representing, not only the rainfall of Madras, but those of Malabar, the Western Ghats and Ceylon, and the Indian pressures.

WE have received from Dr. Hergesell a preliminary report upon the international balloon ascents of October 2 and November 6, 1902. The countries which cooperated in these interesting researches were Austria, France, Germany, Italy (for the first time), Russia, Spain, Switzerland and the United States (Blue Hill Observatory). In October, nearly all the

ascents were made in an area of low barometric pressure. The highest altitudes attained by unmanned balloons were:—Strassburg, 13,700 metres, minimum temperature $-51°·6$ C. (on the ground $5°·2$); Berlin, temperature at starting $4°$, at 13,930 metres $-25°·0$, but the minimum temperature, $-44°·2$, was recorded at an altitude of 9214 metres. On November 6, an altitude of 15,612 metres was reached at Chalais-Meudon, minimum temperature recorded $-55°·2$ (on the ground $11°$); Strassburg, 11,300 metres, minimum $-53°·4$, temperature at starting $-3°·6$; Berlin, 12,985 metres, $-52°·6$ (on the ground $1°·2$). During these ascents, an area of high barometric pressure lay over N.E. and E. Europe, and extended nearly to the western coasts.

THE yearbook of the Meteorological Observatory of Agram for the year 1901 has been received. This is the first volume issued under the new service for Croatia and Slavonia, which is now placed under the superintendence of Dr. Mohorovičić, director of the observatory. Observations for Agram and two other stations were first published in the Austrian yearbook for 1853, and from 1871 by the Hungarian meteorological service. Under the new *régime*, the number of stations which already existed has been considerably increased, and much advantage will necessarily accrue from the fact that greater uniformity will be introduced by the centralisation of the stations under one authority instead of being dependent on at least three local organisations. The publication of the observations is carried out according to the usual international scheme, but the large-folio shape of the work is somewhat inconvenient for library shelves.

MR. C. E. STROMEYER has exhibited to the Manchester Literary and Philosophical Society samples of boiler scale which show excrescences having a striking resemblance to volcanic cones (Fig. 1). Mr. Stromeyer endeavours to show that the formation of these cones is due to unequal heating of the boiler

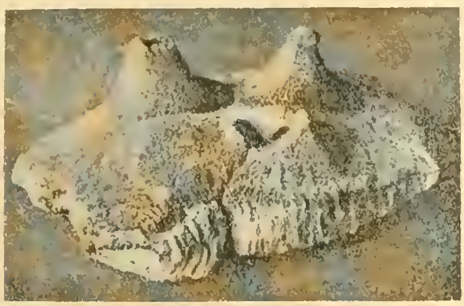

FIG. 1.—Miniature Volcanoes in Boiler Scale.

scale when varying in thickness. He suggests that a similar action may account for the formation of volcanoes and their position near ocean shores. For his arguments upon this subject, we must refer to the *Proceedings* of the Manchester Literary and Philosophical Society for October 21, 1902.

WE have received from Mr. C. T. Whitmell a small brochure entitled "Velocities, Paths and Eclipses in the Solar System," being a paper read before the Leeds Astronomical Society. There is nothing, perhaps, new in the paper, but much that can instruct and interest. We could have wished, however, that the author had been a little clearer in the use of his units. For instance, on p. 2, where a mass of velocities in miles per sidereal hour are given, there is nothing to indicate this, but of course it is readily inferred. The paths of satellites about their respective primaries are very well illustrated, and are especially interesting as showing some of the curves in which our satellite must have moved from the time of its separate existence near the surface of the earth to its present position, and will assume in its possible subsequent career. In the last section of total eclipses, the author considers the cases in which total solar eclipses can be produced on the various planets of the solar system by the interposition of the various satellites. Here, of course, the data are somewhat doubtful, but we have the advantage of seeing in one table the main conditions of the problem.

AMONG other interesting papers in the last number of the *Journal* of the Quekett Microscopical Club, Mr. Wesché gives an account, with figures, of three male rotifers which have hitherto not been illustrated or described fully. He also describes a new mastaxed male, which has not yet been identified. The males have only been seen in about 20 per cent. of the known species of rotifers.

MAJOR RONALD ROSS's report on malaria at Ismailia and Suez has been issued by the Liverpool School of Tropical Medicine. No larvæ of anopheles were detected in the freshwater canal and its branches, and Major Ross ascribes this to the presence of fish, which devour them. Numerous larvæ of anopheles were, however, found in the marshes connected with the natural waters round Ismailia. Major Ross considers that it should be an easy matter to abolish malaria in these districts by drainage of swamps and other measures.

COUNTING the red corpuscles of the blood is a tedious and trying process when great accuracy is aimed at. At the meeting of the Physiological Society on January 17, Dr. C. A. MacMunn showed several lantern slides illustrating how this can be done by photographing the blood, diluted to half or to one per cent., in the hæmocytometer of Thoma-Zeiss. Not only are the red corpuscles seen on the plate, but also all the ruling of the cell. The most suitable power of the microscope for this purpose was found to be a $\frac{3}{4}$-inch objective and Zeiss eyepiece No. 4, with the 6-inch tube-length. About 350 small squares of the instrument are seen on the plate, and if we take, *e.g.*, an average of 7 per square for a dilution of 1 in 200, we have 2450 corpuscles on the plate. A second, a third or more drops can be photographed if necessary, and thus great accuracy can be attained. This method enables one to keep a permanent record of the blood counts, and enables the enumeration to be made at any time that may be convenient. It has numerous applications, obvious to anyone interested in the subject. Of course, the microscope and camera must be used in the vertical position.

REFERRING to the killing of trout by lightning mentioned in last week's issue (p. 304), a correspondent writes to record a similar incident which occurred at Cirencester several years ago. After a vivid flash of lightning, three young gold fish were found dead in their glass bowl near the window of a house. A house not far off was struck by the lightning at the time, and badly damaged.

MR. T. S. HALL, writing from the University of Melbourne, states that from the remarks of Captain G. E. H. Barrett-Hamilton in the British Museum Report on the *Southern Cross* collections, it appears that the Victorian record of the occurrence of the crab-eating seal has escaped notice. The skin and skeleton of one of these seals, a female, caught at Portland, Victoria, in January, 1894, have been on view for some years in the Victorian National Museum. The colour of the skin is a yellowish-white, and the length of the mounted skeleton is about 6 feet 9 inches from snout to tip of tail. A second specimen came ashore at St. Kilda, a suburb of Melbourne, in July, 1897. Its length was 7 feet 4 inches, and it was a pure glossy white. These two occurrences were recorded by Mr. Hall in the *Victorian Naturalist* for August, 1897. Berg's Argentine

record appeared about the same time as the capture of the second specimen. It will be noticed that the first specimen was taken in the height of the Australian summer and the second in the winter.

ATTENTION is directed by Dr. W. Innes, in vol. iv. No. 6 of the *Journal* of the Khedivial Agricultural Society, to the marked diminution which has taken place in the numbers of the more common species of birds met with in the neighbourhood of Cairo. The rock-dove, it is admitted, does an appreciable amount of damage to agricultural products, but the majority of species, and especially the birds of prey, are beneficial. In the last-named group, the diminution in numbers is very noticeable; but quite as serious is the almost total extermination of the cattle-egret, which a few years ago was common on wet lands, or might be seen following the plough in search of mole-crickets and larvæ. "This bird was so common in the past and did so much good that many travellers confounded it with the sacred ibis of ancient times. Although its flesh is poor, this bird has not escaped so-called sportsmen, who kill it simply for the sake of killing." If the birds are not speedily re-habilitated, resort to other and expensive means of destroying deleterious insects will be necessary. The writer urges the authorities to take such steps for bird protection as may seem most suitable without loss of time.

IN the December issue of the *Quarterly Journal of Microscopical Science*, Prof. J. G. Kerr continues his account of the development of the South American lung-fish (*Lepidosiren paradoxa*), treating in this instance of the skin and its derivatives. In a previous communication, the author has referred to the remarkable difference in the appearance of a young Lepidosiren by day and by night, the creature at a certain stage of development being of a deep brownish-black by daylight and quite colourless at night. This change of coloration is found to be associated with the withdrawal of the dendritic pseudopodia of the chromatophores. Attention is directed to the fact that the so-called "cement-organ" is developed from the deep layer of the epidermis, instead of, as in amphibians, from the superficial layer. In another communication to the same journal, Prof. W. A. Haswell describes a new species of cestode worm infesting the alimentary canal of the Port Jackson shark. It belongs to the group in which the "proglottides" are set free from the "strobila" long before full maturity has been reached, and only attain a stage corresponding to the "ripe proglottides" of an ordinary Tænia after having pursued an independent existence for some considerable time.

FURTHER observations on the habits of Hypopeltis, an insect which causes serious damage to the tea bushes, are recorded by Mr. E. E. Green, the entomologist at the Royal Botanic Gardens, Ceylon. There are two periods of inactivity, during January to March, a season of comparative drought, and again from June to August, the season of heavy rainfall. The present paper deals with observations made during the former period. Attempts were made to capture the insects by means of a powerful acetylene light, but failed, partly, perhaps, on account of their relative scarcity; the females when caught were found to contain a large number of eggs, but detailed examination of shoots and leaves showed that very few eggs had been deposited, and such as were found were mostly empty. The writer condemns the system of close plucking, whereby a brush-like formation of small shoots is produced which is particularly suited to the tastes of the Hypopeltis; he points out that systematic capture of the insects would be economical, and suggests an arrangement of cutting up the plantation into blocks, each block being screened off by a narrow belt of trees.

SHORT abstracts of the papers which were read at the International Conference on Plant Breeding and Hybridisation, held in New York last October, appear in the U.S. *Experiment Station Record*, published by the United States Department of Agriculture. The papers by Dr. Bateson and Mr. C. C. Hurst both deal with aspects of Mendel's laws. Allusion was made to the inconstancy of crosses, which often results in reversion, and the explanation was offered that this may be attributed to the crossing of species which are not constant in character. Prof. de Vries took for his subject "Artificial Atavism," defining atavism as the occasional restoration of an old type in a compound cross. The paper by Mr. M. Leichtlin, on some points essential to success in plant breeding, drew forth several remarks on the vitality of pollen, which may maintain its potency for months. Dr. D. Morris gave some account of the experiments which are being made in the West Indies to improve the sugar-cane, and mentioned that improvements have in some cases been obtained by making use of bud variations. The inconstancy of plants produced by crossing finds an excellent illustration in the experiments made by Dr. L. H. Bailey with pumpkins.

THE unique features of the flora and fauna of the Galapagos Islands have been well described by Darwin in the account which he gave of his visit during the voyage of the *Beagle*, and Sir W. J. Hooker remarked upon the similarity of the flora to that of the mainland. The most recent information on this subject appears in a memoir written by Mr. B. L. Robinson and published in the *Proceedings* of the American Academy of Arts and Sciences. Mr. Robinson has, with the aid of specialists, not only worked through the rich collection of plants brought back by the Hopkins-Stanford expedition, but has summarised the results of previous accounts and records. The present more extended knowledge still bears out the specialised nature of the Galapageian flora, which is related to that of the adjacent continent and yet distinguished by peculiar varieties, and which is characterised by discontinuity of species and forms even on adjacent islands. The writer discusses the hypotheses which have been advanced regarding the origin of these islands, and, basing his arguments on the limited possibility of seed transference from the mainland to the islands or from one island to the other, and also upon the opportunity for variation owing to specialised conditions, he is led to favour the theory of emergence.

THE attractive "Open-air Studies in Geology," by Prof. Grenville A. J. Cole, published by Messrs. Griffin and Co., Ltd., in 1895, have now reached a second edition. In the new issue, several changes have been made and the book will thus pursue its useful career with renewed vigour. A few new pictures have also been added.

BOTANICAL material of all kinds required for purposes of instruction has been supplied for some time by Messrs. J. Backhouse and Son, Ltd., York, and many teachers and students have availed themselves of this convenient means of obtaining specimens and preparations. The British Botanical Association has been formed to carry on and extend work of this kind, hitherto undertaken by Messrs. Backhouse. The managing director of the Association is Dr. A. H. Burtt, and the address is The Laboratories, Holgate, York.

A COPY of the third German edition of Prof. E. Mach's "Popular-wissenschaftliche Vorlesungen" has been received from the publisher, Herr J. A. Barth, Leipzig. Fortunately for students of science who do not read German easily, Prof. Mach's popular scientific lectures have been translated into English, and the third English edition contains substantially the same articles as those in the present volume. Students of

physics having but a slight knowledge of German could easily follow Prof. Mach's writings, and would gain both pleasure and profit by becoming acquainted with his many suggestive views.

AMONG scientific articles in the magazines for February, the following are noteworthy. In the *Fortnightly Review*, Mr. Maurice Maeterlinck writes of the beauty of field flowers in his usual charming style. Prof. R. A. Gregory contributes to the *Cornhill Magazine* a paper on the astronomy of the unseen, in which he describes the evidence which has been accumulated in recent years as to the existence of dark stars and other non-luminous matter in the stellar universe. The *Royal Magazine* contains an account, by Mr. W. M. Webb, of school gardens in connection with a number of English schools of different grades; the educational value of nature-study in the open air is accentuated in this essay. Mr. F. W. Stokes contributes to the *Century Magazine* an article on the Aurora Borealis, which is illustrated with four coloured plates reproduced from the author's own paintings.

THE additions to the Zoological Society's Gardens during the past week include a Fennec Fox (*Canis cerdo*) from North Africa, presented by Dixon Bey; a Mandrill (*Cynocephalus mormon*) from West Africa, presented by Mr. M. Vickers; a Buffon's Touracou (*Turacus buffoni*) from West Africa, presented by Mr. V. G. Gane; an Elate Hornbill (*Ceratogymna elata*) from West Africa, presented by Mr. Francis Hart; a Water Rail (*Rallus aquaticus*) British, presented by Lieut.-Colonel L. H. Irby; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, a Great Wallaroo (*Macropus robustus*) from South Australia, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1903 *a* (GIACOBINI).—The following observations of this comet are reported in No. 3841 of the *Astronomische Nachrichten*:—

January 20, 6h. 54m. 12s., Göttingen, α = 22h. 58m. 4s.·8, δ = +2° 30′ 4″. No nucleus.

January 21, 6h. 22m. 0s., Strasburg, R.A. = 22h. 59m. 51s., Dec. = +2° 44′ 8″.

January 21, 7h. 9m. 30s., Heidelberg, R.A.(app.) = 22h. 59m. 52s.·4, Dec. = +2° 44′ 38″, mag. = 10·0.

January 22, 6h. 29m. 30s., Heidelberg, R.A.(app.) = 23h. 0m. 54s.·6, Dec. = +2° 58′ 37″.

RETURN OF PERRINE'S COMET, 1896 vii.—Herr Ristenpart has calculated the corrected elements and the ephemeris, given below, for the return of this comet during the present year.

T = April 26·6, 1903.

$$\left.\begin{array}{l} L = 35°\ 50'\cdot84 \\ \pi = 49\ \ 4\cdot02 \\ \Omega = 242\ 20\cdot40 \\ i = 15\ 41\cdot28 \end{array}\right\} 1903$$

log q = 0·54313

Ephemeris 12h. M.T. Berlin.

Date		α 1903·0 h. m.	δ 1903·0 ° ′	log r	log Δ	Brightness.
Feb. 6·5	...	22 5·9	− 1 27	0·1840	0·3856	0·22
,, 14·5	...	22 28·0	+ 0 21	0·1670	0·3780	0·25
,, 22·5	...	22 52·5	+ 2 17	0·1501	0·3703	0·28
March 2·5	...	23 17·4	+ 4 20	0·1337	0·3627	0·31
April 3·5	...	1 9·0	+12 47	0·0806	0·3385	0·44
May 5·5	...	3 12·7	+18 49	0·0690	0·3354	0·47

Unit brightness at time of discovery (*Astronomische Nachrichten*, No. 3841).

PHYSICAL CONSTITUTION OF JUPITER.—As chairman of the Mathematics and Astronomy Section of the American Association for the Advancement of Science, Prof. G. W. Hough read a paper on the above subject at the Washington meeting held on December 29.

After reviewing the history of the observations of Jovian phenomena, Prof. Hough gave a detailed account of his own observations, which date from 1879. All the measures made by him were micrometrical, and he strongly deprecates the making of mere visual observations wherever it is possible to use a micrometer. Details are given of his measurements of the change of latitude and the rotation period of the Great Red Spot, and the variations are illustrated by four curves which accompany the paper. From the fact that some spots have shorter periods than others, Prof. Hough deduces that the spots must exist at various heights in the planet's atmosphere.

Some observations of transits and eclipses of the satellites led to the deduction that the satellites have no inherent light of their own and that the planet is not hot enough to produce light.

Prof. Hough also draws some very interesting conclusions as to the density and general physical constitution of the planet, and the nature of the various markings seen projected on its surface, and these conclusions argue strongly against the theory that the markings—excepting the belts—are of the nature of clouds in the planet's atmosphere.

The complete address is published in *Science* for January 16.

OBSERVATIONS OF VARIABLE STARS.—Mr. A. Stanley Williams communicates his observations of thirteen recently discovered variables to No. 529 of the *Astronomical Journal*.

DEFINITION OF JUPITER'S MARKINGS. ACCELERATION IN THE MOTION OF THE GREAT RED SPOT.

THE study of Jovian markings has been rendered very difficult for European observers in recent years owing to the position of the planet far south of the equator. Telescopic definition has been rarely good, and the more delicate and diminutive of the surface features have usually been obliterated amid the turmoil of seething vapours in which the image has been involved. The effect of unsteady, confused definition is to smooth off objective irregularities and to produce momentary displacements and contortions, giving rise to false appearances which are sometimes considered real by imaginative or inexperienced observers. When the disc is affected by rushing vapours, the belts often appear as the only distinguishing marks on the planet, and they look even and spotless, so that the observer may readily conclude that Jovian phenomena are temporarily quiescent. But when the disc is outlined with livid sharpness and the details stand out boldly, as they often do in the comparative absence of atmospheric ebullition, the aspect of the planet seems to have been transformed, and a crowd of interesting features immediately present themselves for examination. On special occasions of this kind, it is possible to take between fifty and a hundred transit-times of well-defined marks in the course of a few hours.

On July 11 and 13, 1902, Jupiter appeared in my 10-inch reflecting telescope under a power of 312, magnificently defined. The whole face of the planet seemed figured over with rugged detail. I saw many features on those nights which were not seen again, though repeatedly looked for with the utmost care. The belt scenery was very diversified, and it struck me as being totally dissimilar to the smooth indefiniteness commonly displayed under less suitable conditions. During the progress of my observations at Bristol in recent years, I have usually recorded the state of the seeing, and the following is a summary of the records for the last five oppositions of Jupiter:—

Observations of Jupiter, 1898–1902.

Opposition.	South declination of Jupiter.	Nights of observation.	Nights when seeing record'd	Definition. Very good.	Good.	Fair.	Bad.	Very bad.	Transit-times taken.
1898	1°	51	41	5	8	11	11	6	280
1899	12	76	69	7	13	20	19	10	668
1900	20	36	30	2	7	9	8	4	307
1901	23	76	71	5	10	11	24	21	547
1902	18	89	81	6	14	15	31	15	1005
5 years	..	328	292	25	52	66	93	56	2807

The table shows that the "very good" and "good" nights, taken together, included little more than one-fourth of the aggregate number of observations during which the state of definition was recorded.

Though frequently marred by bad atmospheric conditions, a number of very interesting formations were visible on the planet in 1902. Perhaps the most noteworthy feature of the opposition was the very marked acceleration which occurred in the rate of motion of the great red spot. The longitude of this marking in April, 1902, was 46°, but early in January, 1903, it had declined to 37°, and the resulting mean rotation period during about eight months was 9h. 55m. 39s., or 3 seconds less than the period in 1899, when it was nearly 9h. 55m. 42s. The following diagram will exhibit the changes in the longitude of the spot during the last five years:—

The equatorial region of Jupiter was very brilliant during the past opposition, and the interval separating the dark belts on either side of it seemed filled with glowing material. The usual dark and white spots were distributed along the north side of the south equatorial belt, and the mean rotation period of these was found to be 9h. 50m. 26s.·7, or about 2½ seconds less than last year. The observations indicate that this equatorial current became rather suddenly accelerated towards the close of the opposition. It will therefore be rather important to determine its rate as early as possible in the ensuing spring, when Jupiter reappears in the morning sky. It will also be interesting to observe the position of the red spot in order to find whether the recent marked increase in its motion has been maintained.

W. F. DENNING.

SOCIETY FOR PSYCHICAL RESEARCH.

SIR OLIVER LODGE, in the course of his address before the Society for Psychical Research on Friday last, said that a few friends who desired to remain anonymous had started an endowment fund, amounting at present to 2000*l*., in order to set the Society upon a sound and permanent basis, and in order to provide the material means of attacking the problems which the future might bring before them. As soon as a capital sum of 8000*l*. had been attained, it was proposed to offer a research scholarship in psychical science, to which a holder, irrespective of sex or nationality, might be appointed for one year and from year to year as might seem good, his or her time to be devoted to the work of psychical investigation. When practical benefits could be definitely foreseen, people felt justified in spending money even on science, though as a rule that and education were things on which they were specially economical.

And why should not psychical investigation lead to practical results? Were we satisfied with our treatment of criminals? Were we, as civilised people, content to grow a perennial class of habitual criminals and to keep them in check only by methods appropriate to savages—hunting them, flogging them, locking them up and exterminating them? Any savage race in the history of the world could do as much as that, and if they knew no better, they were bound to do it for their own protection. Society could not let its malefactors run wild any more than it could release its lunatics. Until it understood these things, it must lock them up; but the sooner it understood them the better. Force was no remedy; intelligent treatment was. Who could doubt but that a study of obscure mental facts would lead to a theory of the habitual criminal, to the tracing of his malady as surely as malaria had been traced to the mosquito? And, once we understood the evil, the remedy would follow. It was unwise and unscientific to leave prisoners merely to the discipline of warders and to the preaching of chaplains. That was not the way to attack a disease of the body politic. He had no full-blown treatment to suggest, but he foresaw that there would be one in the future. Society would not be content always to go on with these methods of barbarism; the resources of civilisation were not really exhausted, though for centuries they had appeared to be. The thing demanded careful study on the psychical side, and it would be a direct outcome of one aspect of their researches. The influence of the unconscious or subliminal self, the power of suggestion, the influence of one mind over another—these were not academic or scientific facts alone; they had a deep practical bearing, and sooner or later it must be put to the proof.

They sought to unravel the nature and hidden powers of man; and a fuller understanding of the attributes of humanity could not but have some influence on our theory of divinity itself. If any scientific society was worthy of encouragement and support, it should surely be that. If there was any object worthy the patient attention of humanity, it was surely these great and pressing problems of whence, what and whither that had occupied the attention of prophet and philosopher since time was. The discovery of a new star, or a marking in Mars, or of a new element, or a new extinct animal or plant was interesting. Surely the discovery of a new human faculty was interesting too? Already the discovery of telepathy constituted the first fruits of that society's work, and it had laid open the way to the discovery of much more. Their aim was nothing less than the investigation and better comprehension of human faculty, human personality and human destiny.

THE MEXICAN AXOLOTL.

WHEN I was in Mexico during the last summer, I naturally paid attention to the Axolotl question, a problem which in spite of, or perhaps because of, the various articles written on this subject has remained in a state of confusion. I am now able to make statements which will afford a solution.

In the normal course of events, Amblystoma spawns in the water and the larvæ metamorphose into the entirely lung-breathing, terrestrial creature which alone is sexually ripe.

A. tigrinum, the image of the Axolotl, has a wide distribution, ranging from New York to Colorado and to the valley of Mexico. Velasco,[1] received metamorphosing larvæ of the typical *A. tigrinum* from the little lake Santa Isabel, near Guadeloupe, about five miles north of the capital. There is no reasonable doubt that this species occurs in the perfect form in various other parts of the valley of Mexico, for instance, around Lake Zumpango. A sure sign of the approaching metamorphosis is the appearance of large yellow, irregular patches on the surface, which is at first uniformly dark. By some individuals, this adult coloration is assumed early, when the larvæ are less than half grown; in others it is delayed.

There are various places in Mexico and in the United States where not all the larvæ metamorphose. Some remain more or less uniformly dark, retain their gills and fins, but become sexually ripe. Such typical Axolotl occur side by side with metamorphosing and with metamorposed specimens. Examples:—The Natural History Museum at South Kensington possesses a gravid female, a big typical Axolotl from Anclan, Jalisco; from the same locality are four half-grown larvæ which have assumed the tiger spots, a sure sign of approaching metamorphosis. There are further, from St. Mary's Lake, Estes Park, Colorado, 7400 feet altitude, two full-grown perennibranchiate males in breeding condition and one big female. Lastly, from the Cumbre de los Arrastrados, Jalisco, 8500 feet, there are several young larvæ of the unmistakable spotted type, and one large male larva which is dark and spotless and with all the appearance of not going to change.

In a few favoured localities, none of the larvæ change into the complete Amblystoma, but propagate as permanent Axolotl. This applies to that clan of *Amblystoma tigrinum* which inhabits some of the lakes near Mexico City. It is well known

[1] *La Naturaleza*, vol. iv. (1879), pp. 209-233, pls. vii. ix.; *cf.* also Spengel, who gives a much condensed *résumé* with remarks upon Velasco's paper, *Biolog. Centralblatt*, vol. ii. (1882), pp. 80-83.

that the offspring of these specimens can easily be induced to metamorphose, witness the European stock of Axolotl and Amblystoma, which all have descended from the classical specimens in the Jardin des Plantes.

Velasco's important announcement that regularly metamorphosing Amblystoma occur near the city of Mexico has become complicated by a more recent discovery. The numerous streams of the well-wooded mountain slopes which border the valley of Mexico to the west and south are inhabited by *A. altamirani*, a species very distinct from *A. tigrinum*. This *A. altamirani* metamorphoses regularly. It was described by Dugès.[1] Specimens seem to be very rare in collections, perhaps because nobody has taken the trouble of collecting any since Dugès. The types were found about fifteen miles to the west of the city, at an altitude of about 8800 feet, in the Montes de las Cruzes. On June 18, we went by the Mexican National Railway to the station Dos Rios, 8800 feet above sea-level, and fished out of the streams several dozen spotted larvæ of some three inches in length and several adult males and females in perfect Amblystoma condition. Towards the end of September, we again took some specimens from the same streams. The larvæ averaged perhaps half an inch more in length, otherwise there was no change visible. The adult Amblystomes were still in the water, one of them a beautiful, yellowish albino. On September 28, we went by the

FIG. 1.—Chinampas or "floating" gardens of Lake Xochimilco, June, 1902.

Cuernavaca Railway to the station of Contreras, altitude 8090 feet and in a bee-line about twelve miles south-south-west from the city. Following up various streams, we again found the newts, larvæ and adult, at an altitude from 8500 feet upwards to 8800 feet; further up, the rivulets were apparently too small. The creatures lived in the cool, rushing stream, preferring the sheltered side of large boulders, the larvæ working their gills vigorously, the adult motionless and never coming to the surface; all extremely shy and very quick. One of the specimens was full of nearly ripe eggs.

Searching in the streams only a little above the city, which lies at an altitude of about 7600 feet, was fruitless.

To return to *the* Axolotl, the permanent and sexually ripe larva of *A. tigrinum*. This is restricted to the Lakes Chalco and Xochimilco, to the south and south-east of the capital. No larval or adult specimens of any kind of newt occur in the Lago de Texcoco, the largest of the lakes. Its water is too brackish, and it was already quite undrinkable at the time of the conquest, when this lake extended to and surrounded the city. Its present mean level is six to seven feet below the zero of the town, from which it is about three miles distant. This lake is now silting up fast, since the marvellous drainage canal not only intercepts the dangerous spates of the western streams, but also drains the lake whenever its level rises a few feet. However such a low rise suffices for the lake to extend over many square miles of the neighbourhood, which during the dry period is covered with a white saline crust, interspersed with scanty grass, on which cattle and horses eke out a precarious existence. The lake is not quite dead; it contains several kinds of fish, only one of commercial value, and numerous waterfowl visit it in the late autumn.

Lakes Chalco and Xochimilco are a paradise, situated abou ten feet higher than the Texcoco Lake and separated from it by several hills. High mountains slope down to the southern shores, with a belt of fertile pastures, with shrubs and trees and little streams, here and there with rocks and ravines. In fact, there are thousands of inviting opportunities for newts to leave the lake if they wanted to do so. Close to the southern end of Lake Xochimilco, absolutely clear water wells up from the bottom, forming the famous *ojos de agua* or springs, which are thirty to forty and more feet in depth. Much of the lake, perhaps half of its surface, is filled with the celebrated *chinampas* or "floating gardens," *i.e.* many hundreds of islands surrounded by ever so many wide and narrow canals, here and there with a large stretch of water. Young little islands are still in process of formation, floating masses of entangled peat, rushes, moss and grass. Such floating clumps are caught, combined and anchored by stakes or long saplings of willows and poplars, which are driven into the muddy ground, where they soon take root. The fertile mud is ladled up from the bottom, heaped upon the float, which thereby is converted into an island proper, until a garden is produced in which are cultivated masses of all kinds of flowers, melons, pumpkins, gourds and all other produce, which is taken daily to the market through the Viga Canal right into the city. The larger islands are mostly surrounded by tall poplars, planted in rows along the edges, thus forming a firm boundary. Undue shade is prevented by lopping off the side branches. None of the islands is higher than a foot or two; some are now firm enough to support houses. The depth of the water averages perhaps five to ten feet, shallower towards the north-west, where the lake gradually changes into a swamp of rushes. The further away from the powerful springs, the muddier and darker appears the water, full of suspended fresh and decomposing vegetable matter, teeming with fish, larvæ of insects, Daphniæ, worms and Axolotl. These breed at the beginning of February. The native fishermen who punted us about in dug-outs through this paradise knew all about them; how the clusters of eggs were fastened to the water plants, how soon after the little larvæ swarmed about in thousands, how fast they grew, always remaining dark and never piebald or marbled with yellow, until by the month of June they were all grown into big, fat creatures ready for the market. Indeed, we could not get any small specimens in the month of June, when we paid our first visit. Later in the summer they take to the rushes, in the autumn they become scarce.

None has ever been known to leave the water or to metamorphose, in spite of Valasco's hearsay statement. But *axolotes sin aletas* (*i.e.* without winglets, meaning gills) are called *axolotes del cerro* (mountain-axolotl), or *axolotes sordos* (deaf, having no ears). However, none of these, many of which are undoubtedly *A. altamirani*, are found in the vicinity of the two lakes.

The reason why there are only perennibranchiate, permanent Axolotl in the lakes of Chalco and Xochimilco is obvious. The constant abundance of food, stable amount of water, innumerable hiding places in the mud, under the banks, amongst the reeds and roots, all these points are inducements or attractions so great that the creatures remain in their paradise and consequently retain all those larval features which are not directly connected with sexual maturity. There is nothing whatever to prevent them from leaving these lakes, but there is also nothing to induce them to do so. The same applies occasionally to European newts, of most of which we now know instances of sexually ripe "larvæ." Nevertheless, in the case of our Axolotls the latent tendency to metamorphose can still be revived. When once sexually ripe, the Axolotl are apparently incapable of changing, but that their ancestral *régime* is still latent in them, not quite forgotten, is shown by the metamorphosing offspring of Axolotl bred in Europe.

My explanation suggested itself during our visits to these lakes, which in every respect are so totally different from any other lakes, pools and rivers we have seen in that wonderful country. The only objection is that nobody has thought of this explanation before, but I do not know of any zoologist who has

[1] *La Naturaleza*, 2nd ser., vol. ii. (1896), p. 459.

studied the question on the spot, except de Saussure,[1] who was there some thirty years ago. He suggested that the swamps which extend between the water and the dry land prevented the creatures from gaining the latter and therefore from transforming. But thick rush-swamps fill only the north-western extent of the region. Then Weismann speculated upon the dismal condition of the salt-incrusted surroundings which were supposed to have hemmed in the Axolotl. This dream could apply only to Lake Texcoco, where there are none! The latest suggestion has been made by Herrera,[2] the professor of zoology in Mexico. He puts it categorically that the Axolotl cannot transform for want of food. Fancy the idea that overcrowding of the lakes, which are teeming with food, causes famine and at the same time produces big, oily, fat Axolotl!

The inducements to remain in the water, their birthplace, have become too strong for the larvæ to yield to their innate tendency of further development. Nothing is stunted in their bodies. On the contrary, they become to a certain extent overgrown, and the sexual organs, which anyhow in most terrestrial Urodela are active only during the temporary aquatic life, undergo their normal course of development and function. H. GADOW.

ISOMERIC CHANGE IN BENZENE DERIVATIVES.[3]

IN recent years, it has become realised that in many chemical reactions, isomeric changes—that is, the change of a given substance into another of identical composition, but possessing a different and under the conditions a more stable constitution—play an important part; thus, as is well known, from the salts of certain organic acids, the acid frequently cannot be obtained, but a neutral isomeride (the pseudo-acid) into which the acid changes is alone isolated. One very interesting instance of isomeric change is to be found in the process of substitution in certain benzene derivatives. As long ago as 1887, Armstrong suggested that the ready production of para-derivatives from amino- and hydroxy-aromatic compounds—anilines and phenols—was due to the formation initially of isomeric compounds in which the amino- or hydroxylic hydrogen was displaced by the substituting group. Since that date, these labile precursors (phenyl chloramines, nitramines, &c.) of the ordinary substitution products (chloro-, nitro-anilines, &c.) have been isolated in numerous cases. They can always be transformed into the stable isomeride, but this change seems to be conditioned by the presence of some other substance—the catalyst. As Armstrong has suggested, these isomeric changes are "fermentative" in character, often taking place with great facility and under the influence of minute amounts of the catalyst. Measurements of the velocity show that changes of this type are always apparently monomolecular (that is, each molecule changes *per se*); but such a result only proves that the slowest reaction is monomolecular and does not exclude the possibility of the simultaneous occurrence of other more rapid transformations, which form part of the complete change.

A most instructive example of isomeric change is found amongst diazobenzene derivatives. The diazobenzene salts are derived from the base, diazonium hydroxide, to which is now generally assigned the expression $Ph.N(OH) \equiv N$. On treatment with alkalis, this base is converted into the salts (diazotates) of an isomeric acid, to which the formula $Ph.N:N.OH$ is given. On attempting to isolate the acid from these salts, a neutral isomeric substance (the pseudo-acid) is obtained; this is probably a phenylnitrosamine, $Ph.NH.NO$. In this paper, the author describes a new case of intramolecular change of a remarkably interesting kind:—Chloro- and bromo-benzenediazonium hydroxides, $C_6H_2X_3.N(OH) \equiv N$, readily change into isomeric hydroxybenzene derivatives, $C_6H_2X_2(OH).NX \equiv N$, the hydroxyl group and one of the halogen atoms (an ortho-placed halogen atom) having exchanged positions. This change not only affords another illustration of the transference of a group from the side chain of an aromatic compound into the benzene nucleus, but further shows the tendency, which has been occasionally noticed, for an ammonium base to change into an isomeric substance of neutral character. Under all conditions, when it is possible for the diazonium hydroxide to be present, the wandering of the hydroxyl group takes place. Thus in dilute aqueous solution of such diazonium salts as the nitrate or the hydrogen sulphate, the small quantity of diazonium hydroxide which arises from hydrolytic dissociation undergoes this change. In the presence of excess of acid, there is no hydrolytic dissociation and consequently the isomeric change does not take place. In the case of the salt of a weak acid, as the acetate, where the hydrolytic dissociation is considerable, the rate of interchange of halogen for hydroxyl is greatly increased. In the naphthalene series, this intramolecular change occurs with even greater ease and rapidity than in the benzene series.

The elucidation of the nature of the process by which halogen is eliminated from diazobenzene compounds (a reaction first observed by Meldola in the naphthalene series) has rendered possible the removal of certain errors in the statements regarding the changes undergone by diazonium compounds. Thus Hantzsch has recently stated that *s*-tribromobenzenediazonium hydroxide, $C_6H_2Br_3.N(OH) \equiv N$, changes into the corresponding phenyl nitrosamine, $C_6H_2Br_3.NH.NO$, not realising that under the conditions (presence of acetic acid) an isomeric change has taken place, bromine being eliminated.

[1] *Verhandl. Schweizer naturforsch. Gesellsch. Einsiedeln* (1868), p. 89.

[2] *La Naturaleza*, 2nd ser., vol. iii. (May, 1900).

[3] Abstract of paper on "Isomeric Change in Benzene Derivatives—The Interchange of Halogen and Hydroxyl in Benzenediazonium Hydroxides." By Dr. K. J. P. Orton. Read before the Royal Society December 4, 1902.

A DAYLIGHT PHOTOMETER.

A "DAYLIGHT PHOTOMETER" described by Mr. A. H. Munsell, of Boston, Mass., is designed mainly for the comparison of the brightnesses of various coloured surfaces illuminated by daylight or artificial light. The instrument consists essentially of two "cat's-eye" shutters placed symmetrically towards a source of diffused light. Through one of these the light falls on the coloured surface to be tested, through the other upon a standard white surface. The second shutter is then gradually closed until the resulting grey produced on the white screen just matches the coloured surface in intensity, whilst a dial connected with this shutter shows, in percentage, how much darkening has been necessary to match the coloured surface under test. The instrument has also been applied to the testing of light transmitted through coloured media. Owing to the wide variation in the sources of light used, as well as in the colour perceptions of different observers, no degree of absoluteness can be attached to the readings. As Purkinje and Dove showed, the relative brightness of two differently coloured surfaces changes as the strength of the illuminating source is altered. But although the readings of the instrument must for these reasons be interpreted with great caution, the arrangement seems capable of supplying much interesting information on the variations of colour perception under different conditions. ALBERT CAMPBELL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It was agreed by the senate on January 29, by a large number of *placets* to one *non-placet*, to appoint two additional demonstrators of human anatomy.

The funeral service for the late Master of Caius, Dr. N. M. Ferrers, F.R.S., took place privately in the college chapel yesterday, February 4. The public service for the late Sir G. G. Stokes, F.R.S., Master of Pembroke, is to be held in St. Mary's Church to-day, and will be attended by a large number of members and officers of the University and representatives of learned societies.

By the will of the late Mr. F. J. Quick, of Trinity Hall, the residue of his estate, valued at some 50,000*l*., is placed in trust for the promotion of study and research in vegetable and animal biology. The University is to draw up a scheme for the administration of the trust, wherein it shall be provided that no office or appointment paid from the income of the fund shall be held by the same person for more than three years without being thrown open for a fresh election.

The election to the Lucasian professorship, vacant by the death of Sir G. G. Stokes, will take place at noon on February 28. The electors are the heads of colleges.

Miss I. Sollas, Newnham College, has been nominated to

occupy the University table at the Plymouth Marine Biological Laboratory.

Dr. W. N. Shaw, F.R.S., is to lecture on Thursdays during the present term on the physics of the ventilation of buildings. The lectures are given in the Cavendish Laboratory at 4.30 p.m.

The Arnold Gerstenberg studentship, value 90*l.* for two years, will be awarded in the Lent term, 1904. It is open to men and women who have obtained honours in the natural sciences tripos and propose to pursue philosophical study. The award will be made by means of essays on subjects set forth in the *University Reporter* (p. 431).

DR. G. N. STEWART, of Cleveland, U.S.A., has been offered and has accepted the professorship of physiology in the University of Chicago.

SPEAKING at a meeting of the Derbyshire Dairy Farmers' Association at Derby, on January 30, the Duke of Devonshire said he did not know what our educational system, as it had too generally been administered in the past, had done for the advantage of the farmers. They had seen it mainly from this point of view—that it had taken the best and brightest boys and girls from the country districts away to employment in the towns, and that it had done nothing to improve the character of the labour which was still left to them in the country. The education which the children received in rural districts might have been such as to fit the children for occupations in towns in various branches of industry, but it had not been such as to make a boy or a girl a better member of the agricultural community. What they wanted was, first, to form the character of the children, to make them honest, industrious, more reflecting and steadfast; and, next, to improve their intelligence so that they might be more capable of doing whatever class of work might fall to their lot in life in a better, more conscientious and intelligent manner. The village school which did not have this effect upon the children was not a school conducted as it ought to be. What was wanted for the children was not the cramming of them with facts, but teaching them something which might be applied to their daily life and might so interest them that they would prosecute its study after they left school and thus fit themselves more effectively for their daily labour, whether it were in the town or in the country. The training of their teachers had hitherto been too exclusively of a literary character, with, perhaps, a scientific smattering. It had not been directed to those subjects which related to agricultural life, to farming, dairying or the household.

IN proposing the toast of "The Mining and Metallurgical Industries," at the 30th annual dinner of the Royal School of Mines on Tuesday, the chairman, Mr. A. C. Claudet, referred to the steps that had been taken by the council of the Institution of Mining and Metallurgy with a view to effect the reorganisation of the Royal School of Mines. The *Times* reports Mr. Claudet to have said that, in the interests of the Empire no less than of the mining and metallurgical industries, prompt and far-reaching action was imperatively necessary if British-trained mining engineers and metallurgists were to hold their own in the future with foreign-trained engineers, and it was this conviction which led the council of the institution to take the matter in hand. Systems in force in America and elsewhere had been investigated, and the results communicated to the council of the college, with certain recommendations and the offer of material assistance in carrying them out. The matter was receiving the serious attention of the Board of Education, and the council of the institution had good grounds for feeling confident that comprehensive improvements would be effected at no distant date. It was believed that, if nothing unforeseen happened, British mining and metallurgical students would soon have facilities for training equal to the best in the world. The institution council proposed that a post-graduate course in practical work in mines and works at home or abroad should be established, and they had offered to give very material assistance in providing the necessary facilities for such a course on lines which they believed would be of the greatest possible benefit to British graduates. In connection with this post-graduate course the institution had presented scholarships to the Royal School of Mines, and to three or four other colleges as a beginning, and it was hoped that before long further scholarships and prizes would be available. The endowments and grants by Government in connection with mining and metallurgical training in this country were, as every one knew, ridiculously inadequate, and out of proportion to the vast interests involved—interests not merely local, but affecting the whole British Empire. However, there were many signs that the Government and other authorities were alive to the necessity of doing something promptly for this branch of education, and if they pressed their claims strongly and persistently he had no doubt at all that they would be met in a satisfactory manner. There was every reason to believe that their school would again occupy the position it once held, and ought still to hold—that of the premier mining school of the Empire, and second to none in the world.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 22.—"On the Electrodynamic and Thermal Relations of Energy of Magnetisation." By Dr. J. **Larmor**, Sec. R.S.

The main points which the author has sought to bring out in this paper are as follows:—

(1) In an electrodynamic field, there exists the usual specification of electrokinetic energy, but also *in addition* the energy of magnetisation of magnetic material.

(2) This energy of magnetisation appears as made up of a part given by the ordinary formula, which (when paramagnetic) is derived from thermal sources, and so in the absence of hysteresis has the limited mechanical availability of thermal energy, together with a local part which is to some extent thus available, but is also in part permanent intrinsic energy of the molecules, regarded temporarily as magnetic energy.

(3) The law of Curie, that the susceptibility of weak paramagnetic substances is inversely proportional to the absolute temperature, is involved in these statements.

(4) The extent of the direct (non-thermal) availability of *retained* magnetism can be inferred only by empirical procedure, for example, in general features by inspection of the hysteresis diagram as pointed out by Lord Rayleigh.

Physical Society, January 23.—Prof. S. P. Thompson, president, in the chair.—A paper on an oscillating table for determining moments of inertia was read by Mr. W. H. **Derriman.** The apparatus consists of a circular wooden table which can be suspended from a wire by means of brass supports. A pointer is attached to the centre of the bottom of the table and immediately below is another fixed pointer. In the top of the table a circular groove is cut, in which pieces of lead can slide. These pieces of lead form together half of a circular ring of rectangular cross section. The body, the moment of inertia of which is required, is placed in position on the table, and the lead weights moved until the two pointers are opposite to one another. The table therefore always oscillates about the same axis, and since the lead weights are at a fixed distance from this axis, the moment of inertia of the table remains constant. The apparatus can be employed for determining the moment of inertia of a body about any axis, and is useful for proving the law that the moment of inertia of a body about any axis is equal to its moment of inertia about a parallel axis through its centre of gravity, together with the moment of inertia of the whole mass, collected at its centre of gravity, about the given axis.—Mr. **Skinner** described an inertia balance by means of which moments of inertia can be determined without the use of stop watches. The table which carries the body is suspended by a wire. Fixed to the centre of the bottom of the table there is another wire, similar to the first, but twice as long. This wire carries a screwed brass bar, the axis of the bar being at right angles to the wire. At the middle point of this wire there is a pointer fixed at right angles to it, and on the brass bar are two weights which can be placed at varying distances from the axis. To the bottom of the bar is attached a fourth wire, the same length as the first one, and its lower end is clamped. By arranging so that the upper table oscillates to the left when the bar is oscillating to the right, and adjusting the weights on the brass bar until the pointer is stationary, the moments of inertia of bodies placed upon the table can be determined. The chairman referred to an inertia table designed by Prof.

Perry in which an aluminium ring was supported by a trifilar suspension.—A paper entitled "Note on an Elementary Treatment of Conducting Networks," by Prof. L. R. **Wilberforce**, was read by Mr. Derriman. In this paper the author shows that the well-known reciprocal relations between the parts of a conducting network can be readily established without an appeal to the properties of determinants.—A paper on the theory of the quadrant electrometer was read by Mr. G. W. **Walker**. For the purpose of some experiments which the author is taking up, he has found it necessary to examine carefully the theory of a symmetrical quadrant electrometer, and the results of his investigations are put forward in this paper. The late Dr. John Hopkinson pointed out the imperfection of the usual formula given by Maxwell, and also gave an empirical formula which closely represented his experiments. The general result is well known, namely, that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. The author's experiments have been made with a sensitive electrometer by Bartels, of Göttingen, which shows a maximum sensibility when the potential of the needle is about 100 volts. The sensibility seems to go on diminishing after this, at least until very high voltages are used. The formula for a quadrant electrometer is investigated more rigidly than in the text-books, and an equation is arrived at which is practically identical with the empirical formula of Hopkinson, and represents exactly the results obtained by the author from a Bartels' electrometer. The equation contains a constant which must be positive to explain the results, and it is shown that this is the case. An investigation is then undertaken to obtain a numerical value for this constant.

Zoological Society, January 20.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—Mr. **Budgett** read a report on his recent expedition to Uganda. At Butyaba, on the east shore of Lake Albert, *Polypterus senegalus* and *Protopterus aethiopicus* were both abundant, and collections were made of the fishes of the lake and of the higher vertebrates. Mr. Budgett proceeded through the Budonga forest, where very large herds of elephant were frequently seen, to the Victoria Nile below the Murchison Falls. Here ten days were occupied in endeavouring to obtain the early stages of Polypterus, which was fairly abundant and was found to be spawning. The fertilisation of more than a hundred ova obtained, however, was not successful, and the most promising attempt yet made to breed Polypterus artificially again failed. Mr. Budgett proceeded to Wadelai overland, staying there a week, but was not very successful here in obtaining material of Polypterus; but some collections of fishes and birds were made. At Fashoda, several weeks were spent, and a good deal of information concerning *Polypterus senegalus*, *P. bichir* and *P. endlicheri* was obtained. Many anatomical preparations of fishes were also made here. Throughout the journey, many observations were made upon the birds and mammals, and the striking parallelism of the country of the Nile province of Uganda in its flora and avifauna to that of the Gambia colony on the west coast was especially noticed. Though some new light was shed upon the problem of the life-history of Polypterus, earlier stages than those previously observed were not obtained.—Mr. J. S. **Budgett** also read a paper on the spiracles of Polypterus, in which he stated his opinion that the spiracles of this fish were used to take in and give out air from the swim-bladder.—Mr. F. E. **Beddard**, F.R.S., read a communication dealing with the surface anatomy of the cerebral convolutions in Nasalis, Colobus and Cynopithecus. The wide differences which the brain of Cynopithecus shows from that of the baboons and its many points of resemblance to the brain of Semnopithecus were pointed out. Colobus was shown to closely resemble Macacus in the structure of its brain. Three brains of Nasalis were reported on, two of which the author owed to the kindness of Dr. Charles Hose, of Borneo. It was stated to be practically impossible to distinguish the brain of this genus from that of Semnopithecus.—Mr. G. A. **Boulenger**, F.R.S., read a paper on the fishes collected by Mr. G. L. Bates in Southern Cameroon. Examples of thirty-five species were contained in the collection; these were enumerated and the new species, nine in number, were described. One of the species was made the type of a new genus—Micrnsynodontis.—A communication from Mr. W. K. **Hutton** contained an account of the anatomy of a gephyrean worm from the Firth of Clyde. As the worm appeared to be hitherto undescribed, Mr. Hutton proposed to name it *Phascolosoma teres*.—A communication from Dr. J. G. **de Man** contained the description of a new species of fresh-water crab from Upper Guinea, under the name *Potamon (Potamonautes) latidactylum*.—Mr. R. I. **Pocock** read a paper, prepared by the Hon. N. C. **Rothschild** and himself, containing a description of a new species of spider of the genus Phrynarachne, discovered by Messrs. Rothschild and E. E. Green in Ceylon. The members of this genus were noteworthy on account of the perfection of their imitation of a patch of bird's dung, which acted as a lure to butterflies.—A communication received from Dr. H. J. **Hansen**, of Copenhagen, contained a monograph on the crustacean genera Sergestes and Petalidium, with an excursus on the luminous organs of *Sergestes challengeri*, n.sp. During a visit to England last summer, Dr. Hansen was empowered by the authorities of the British Museum (Natural History) to examine all the specimens of reputed species of these genera preserved under their care in the extensive "Challenger" Collection. A minute investigation of all the specimens called for some systematic changes, but on the whole confirmed the view which he had expounded in 1896, namely, that many specific names had been needlessly applied to larval forms of species already known in the adult condition. On the other hand, Dr. Hansen found one single specific name covering specimens of four distinct species, two of these being new to science, and one of the new ones being exceptionally remarkable for the possession of luminous organs. These, which were not known to occur in any other species of the genus, were distributed in great numbers over the whole fabric of *Sergestes challengeri*.

EDINBURGH.

Royal Society, January 5.—Prof. Flint in the chair.—A paper by Mr. George **Romanes** was communicated in which the author argued that it was not necessary to suppose that the earth in the course of its evolution had passed through a molten or semi-fluid condition. He showed by definite calculations that the great compression of the interior parts of the earth implied an evolution of heat sufficient for all purposes. The paper gave rise to a lively discussion as to the internal condition of the earth and its probable history, Prof. Knott pointing out that the Helmholtz theory of gravitation, when applied to the earth in its present state, amply sufficed to account for the annual loss of heat. A very slight contraction would prevent the average temperature becoming lowered, although a certain amount of heat was lost every year.—In a paper on the isoclinal lines of a differential equation of the first order, Mr. J. H. Maclagan **Wedderburn**, following Lie's idea of a differential equation, namely, that the equation $\phi(x, y, p)=0$ attaches to every point (x, y) a direction $p\,(=dy/dx)$, discussed geometrically the singular loci of the integral curves by means of the singular loci of the family of curves obtained by regarding p as an arbitrary constant. This family it is proposed to call the isoclinal family. An isoclinal line has the property that the differential equation attaches the same direction to every point on it. The cases dealt with were where the p discriminant was (1) an envelope of the isoclinal family, (2) a locus of nodes, (3) a locus of cusps, the corresponding loci on the integral curve being (1) a locus of cusps, (2) a tac locus, (3) a locus of ramphoid cusps. Tac loci were divided into three classes, according as the curvature was in the same or opposite direction in the two cases, or an inflection on one of the curves. The method was applicable to equations of higher order than the first, and to partial differential equations.

January 19.—Lord Kelvin, president, in the chair.—Lord **Kelvin** read a paper on the reflection and refraction of light, in which further developments were given of two previous papers. In the earlier of these (*Phil. Mag.*, August, 1900), the dynamical difficulty of conceiving ponderable bodies capable of motion through the highly elastic solid such as ether seems to be was surmounted by supposing that within the sphere of action of an atom of matter the ether varied in density according to definite laws conditioned by assumed attractions and repulsions between the atoms and the elements of ether. As the ether flowed through the space occupied by the matter, or as the atom passed through the ether, the ether was imagined to become condensed towards the centre and rarefied towards the surface of the spherical atom in such a manner that the amount of ether within the spherical boundary was the same as if no atom were present.

This condensation and rarefaction of the ether gave to the matter a quasi inertia, in virtue of which particular kind of loading of the ether the velocity of light was affected and a change of refractive index produced. In the second paper referred to (see *Archives Néerlandaises des Sciences*, &c., November, 1901), the single electric fluid theory of Aepinus was "atomised," the negative electricity consisting of minute atoms called electrions much smaller than the atoms of ponderable matter. These electrions freely permeate the spaces occupied by the material atoms as well as empty space. They repel one another, but attract the atoms of matter, and the atoms of matter also repel one another. The electrions passing within the spherical atom tend to neutralise the action of the atom of matter, and in the overlapping of two atoms and the consequent transformation of old configurations of equilibrium of the atoms and the associated electrions into new configurations, an endless scope was found for explaining many electrical phenomena. Any such change in configuration would be followed by the electrions vibrating about their new positions of equilibrium and sending off ethereal waves through space. The non-neutralised material atom is supposed to repel the ether and the electrion to attract it. In the neighbourhood of a neutralised atom, the ether is unaffected; but within the atom there are condensation and rarefaction of the ether, depending upon the particular distribution of electrions within it. When we consider the behaviour of such a dynamical system in regard to trains of ethereal waves incident upon it and, it may be, passing through it, not only are the well-known Fresnel laws for the reflection of polarised light at once obtained, but the phenomenon of metallic reflection finds an immediate explanation.—Sir John **Murray** and Mr. Laurence **Pullar** presented the first of a series of communications on the bathymetrical survey of the fresh-water lochs of Scotland, this first paper dealing with the lochs of the Tay Basin. During last summer, the work had been vigorously prosecuted, depths, temperatures, vegetable and animal life being specially studied. The oscillations familiar to the Swiss geologists and known as *Seiches* were also observed.—Dr. **Horne** followed up this paper with a lucid account of the geological features of the Tay Basin, illustrating the tectonic structure of the Highlands by means of sections, and drawing attention to the succession of uplifts and denudations which had affected the Tay Basin during geological time. The importance of the results obtained by Sir John Murray and his associates was dwelt upon, especially in regard to the strong evidence in favour of the glacier origin of certain of these lochs, notably Loch Tay itself, which could be nought else than a true rock basin produced by ice erosion.

PARIS.

Academy of Sciences, January 26.—M. Albert **Gaudry** in the chair.—Researches on the chinchona alkaloids: cinchonine, cinchonidine and cinchonamine, by MM. **Berthelot** and **Gaudechon**. A thermochemical paper giving the heats of combustion, formation and solution of these alkaloids and some of their salts. Recently precipitated cinchonine appears to possess the same physical state as crystallised cinchonine; cinchonidine behaved in a similar manner.—On some functions and point vectors in the motion of a fluid, by M. Paul **Appell**.—On the reducibility of differential equations, by M. Paul **Painlevé**.—The theory of the absorption of light by symmetrical crystals, by M. J. **Boussinesq**.—On the magnetic deviability and the nature of certain rays emitted by radium and polonium, by M. Henri **Becquerel**. It has been shown that the radiation from radium is partly deviated by a magnet, and that this portion of the rays is identical in properties with the kathode rays. The other part, considered as unaffected by a magnetic field, consists of two kinds of rays, one very penetrating and the other easily absorbed. The latter have recently been identified by Rutherford, under the name of the α-rays, with the canal rays of Goldstein. The electrical method used by Rutherford was one of extreme delicacy, but it appeared desirable to confirm this result by an independent method, and for this purpose measurements were made by a modification of the photographic method previously used by the author. The results were in general agreement with Rutherford's experiments, the α-rays resembling the canal rays in carrying positive charges with greater masses and smaller velocities than those of the kathode rays.—On the use of a telegraph wire for registering automatically earth vibrations and measuring their velocity of propagation, by M. G. **Lippmann**. In a continuous seismograph, considerations of cost necessitate a reduction of the curve to small dimensions, and an apparatus designed to give the curves on a large scale must be started during the earthquake, with the result that the first portion of the record is lost. A telegraphic arrangement is described by the author by which the arrival of the seismic wave at a distant station works a relay, starting the clockwork of the recording apparatus at a second station, advantage being taken of the relatively slow rate of transmission of the seismic disturbance. The same apparatus will also serve to measure this rate.—The principal results obtained in 1902 on the radial velocities of the stars, and on the causes of error peculiar to these researches, by M. H. **Deslandres**. The causes of error are numerous: optical and mechanical defects in the telescope and spectrograph, errors in adjustment, the effects of temperature changes on the flexure of the supports, and the varying condition of the atmosphere.—On two recent comets, by M. **Perrotin**. Of the two comets recently discovered by M. Giacobini at the Observatory of Nice, the first is new; the second may be identical with the Tempel-Swift comet, the return of which is expected about this time.—On the fourth campaign of the *Princess Alice II.*, by Prince **Albert I. of Monaco**. The work was carried out partly in the Mediterranean and partly in the North Atlantic. A summary of the results obtained in oceanography and zoology is given. In view of the results of M. Armand Gautier on the normal presence of arsenic in the animal organism, systematic search for this element was made on the animals caught during the voyage by M. Gabriel Bertrand, M. Gautier's views being completely confirmed.—The eruptions of dense clouds from Mont Pelée, by M. A. **Lacroix**. It was found possible to fix approximately the temperature of one of the hot blasts at a distance of 6 kilometres from the volcano; it was lower than the melting point of tin (230° C.) and higher than 125° C., since the latter was the temperature found for a layer of ashes some time after the eruption.—The Observatory of Besançon. The elements of the Giacobini comet (1902 *d*), by M. P. **Brück**, and observations of the Giacobini comet (1903 *a*), by M. P. **Chofardet**.—On regular differential systems, by M. Ch. **Riquier**.—On induced radio-activity and on the emanation from radium, by M. P. **Curie**. In a former note it was shown that the disappearance of the radio-activity induced by radium in a closed vessel and maintained at a constant temperature followed an exponential law with the time. Similar experiments have now been carried out at 450° C. and −180° C., and it has been found that the law is the same. From these results it is regarded as improbable that the effects accompanying the existence of the emanation can have their origin in chemical action, since there is no known chemical reaction the velocity of which remains constant over a temperature range from −180° C. to +450° C.—On the micrography of the nickel-steel alloys, by M. Léon **Guillet**.—On the existence of electrolytic superoxides of lead, nickel and bismuth, by M. A. **Hollard**. From the chemical formula, any weight of lead peroxide deposited electrolytically, multiplied by 0.866, should give the weight of lead.—Experiments were carried out with amounts of lead varying from 0.01 gr. to 10 gr. of lead, and the amount of peroxide deposited weighed. The results show that the factor 0.866 is only approached when large quantities of lead are present, the factor falling to 0.74 for the smallest amount. The author interprets this as being due to the formation of a higher oxide of lead, but no direct evidence of this is produced. Similar experiments with nickel and bismuth lead to the conclusion that the oxides NiO_4 and Bi_2O_7 can be separated electrolytically.—On the equilibria produced between copper, silicon and manganese, and on the silicide of manganese Si_2Mn, by M. P. **Lebeau**.—On two acids containing phosphorus derived from methyl-ethyl-ketone, by M. C. **Marie**.—On a new diiodophenol, by M. P. **Brenans**.—On the rotatory power in homologous ethers of borneol, isoborneol and camphocarbonic acid, by MM. J. **Minguin** and Gr. de **Bollemont**.—On the chlorination of aromatic substituted hydrocarbons by ammoniacal plumbic chloride, by MM. A. **Seyewetz** and P. **Trawitz**. The chlorinating action of $(NH_4)_2PbCl_6$ on chloro-, bromo-, iodo- and nitro-derivatives of aromatic hydrocarbons has been studied. Ortho-chlor-toluene is attacked ex-

clusively in the methyl group; the para-derivative behaves similarly.—Researches on the $\alpha\beta$-dimethylglutaric acids, by M. E. E. **Blaise.**—The preparation and properties of 1:6 hexanediol or hexamethylene glycol and its principal derivatives, by M. l'Abbé J. **Hamonet.** Diphenoxyhexane is converted into diiodohexane by the action of hydriodic acid, and from this the acetin is obtained and hydrolysed, yielding the glycol, the properties of which are described.—Contribution to the physiology of the internal ear, by M. **Marage.** The experiments described are not in exact accordance with either of the current theories of audition. A third theory is developed, one of the consequences of which is that the variations of pressure in the internal ear are of the same order as actions affecting other nerves. The acoustic nerve thus ceases to be exceptional in its behaviour.—The evolutive cycle of tissues deprived of their intimate relations with nerves, by M. N. Alberto **Barbieri.**—On the ovule and fertilisation in the Asclepiadeæ, by M. Paul **Dop.**—Contribution to the study of the epiplasm in the Ascomycetes, by M. A. **Guilliermond.**—On a cave containing fossils near Châteauneuf-les-Martignes, by MM. A. **Cotte** and Ch. **Cotte.**—On the former existence of a direct communication between the Parisian and Belgian basins, by M. Maurice **Leriche.**—On the laccolites on the north side of the Caucasus, by Mlle. Véra **Devis.**—On a drawing in the cave of Mas-d'Azil, by M. Edouard **Piette.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 5.

ROYAL SOCIETY.—In consequence of the death of Sir George Gabriel Stokes, no meeting will be held.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

CHEMICAL SOCIETY, at 8.—(1) A New Vapour-Density Apparatus; (2) A New Principle for the Construction of a Pyrometer: J. S. Lumsden.

LINNEAN SOCIETY, at 8.—Stephanospermum, Brongniart, a Genus of Fossil Gymnospermous Seeds: Prof. F. W. Oliver.

RÖNTGEN SOCIETY, at 8.30.—Discussion on Some Points suggested by the Presidential Address of November, 1902, opened by J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Adjourned Discussion on the Metric System.

FRIDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 9.—George Romney and his Works: Sir Herbert Maxwell, Bart.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—The President will deliver an address on The Recent Geological History of the Bergen District of Norway.

MONDAY, FEBRUARY 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Changes in the Neapolitan Coast Line: R. T. Günther.

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

TUESDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

SOCIETY OF ARTS, at 5.—Women in Canada: Countess of Aberdeen.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—On Two Medicine Baskets from Sarawak: R. Shelford.—The Lo-Los and other Tribes of Yunnan: A Henry.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Manufacture and Efficiency of Armour-piercing Projectiles: D. Carnegie.

WEDNESDAY, FEBRUARY 11.

SOCIETY OF ARTS, at 8.—The Port of London: Dr. B. W. Ginsburg.

THURSDAY, FEBRUARY 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Tempera ure: Miss S. C. M. Sowton and J. S. Macdonald.—On the Negative Variation in the Nerves of Warm-Blooded Animals: Dr. N. H. Alcock.—On the Optical Activity of Hæmoglobin and Globin: Prof. A Gamgee, F.R.S., and A. Croft Hill.—On the Nucleo-Proteids of the Pancreas, Thymus and Suprarenal Gland, with especial reference to their Optical Activity: Prof. A. Gamgee, F.R.S., and Dr. W Jones.—Studies in the Morphology of Spore-producing Members. No. V. General Comparisons and Conclusion: Prof. F. O. Bower, F.R.S.—Primitive Knot and Early Gastrulation Cavity coexisting with Independent Primitive Streak in Ornithorhynchus: Prof. J. T. Wilson and J. P. Hill.—The Brain of the Archæoceti: Prof. Elliot Smith.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the adjourned discussion on the Metric System is concluded at the Meeting on February 5, the adjourned discussion of Messrs. Scott and Esson's paper will be taken.

MATHEMATICAL SOCIETY, at 5.30.—Note on a Point in a Recent Paper by Prof. D. Hilbert: E. T. Dixon.—Some Properties of Binodal Quartics: H. Hilton.—The Field of Force due to a Moving Electron: Prof. A. W. Conway.—On Birational Transformations of the Type of Inversion: Prof. W. Burnside.

FRIDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 9.—Health Dangers in Food: Prof. Sheridan Delépine.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 5.—Address by the President elect.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Address on the Molluscan Larva in Classification: Prof. G. B. Howes, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of Tunnels in the London Clay: H. A. Bartlett.

CONTENTS.

SUPPLEMENT TO "NATURE."

THE LATE LORD LILFORD.

Lord Lilford on Birds. Being a Collection of Informal and Unpublished Writings by the late President of the British Ornithologists' Union. With contributed Papers upon Falconry and Otter Hunting, his favourite Sports. Edited by Aubys Trevor Battye, M.A., F.L.S., &c., Member of the British Ornithologists' Union, and illustrated by Archibald Thorburn. Pp. xvii + 312. (London: Hutchinson and Co., 1903.) Price 16*s.* net.

Lord Lilford. Thomas Littleton, Fourth Baron, F.Z.S., President of the British Ornithologists' Union. A Memoir by his Sister. With an Introduction by the Bishop of London. Illustrations by Thorburn and Others, and a Portrait in Photogravure. (London: Smith, Elder and Co., 1900.)

THE figure of the late President of the British Ornithologists' Union, one of the earliest supporters of the *Ibis*, seen as sketched unconsciously by himself in the extracts from private correspondence and diaries given in Mr. Trevor Battye's beautifully got up and illustrated volume, and in the memoir published a little earlier by a sister, is very attractive and very pathetic—the bodily presentment of the fascination of wild nature triumphant over pain.

Lord Lilford's life is the story of "a buoyant and vigorous nature, slowly cut off by the inexorable trammels of physical disability from what it most keenly enjoyed, the opportunity of personal observation in a large sphere, the delight of new impressions, the large sympathy with a perpetually increasing world of nature and man," but retaining to the end the lightheartedness and kindly consideration for others, and the absorbing interest in bird and beast which distinguished him as a boy.

The words quoted above in inverted commas are taken from Bishop Creighton's introduction to Mrs. Drewitt's book.

The prematurely old man, crippled with gout, who hopes it may clear up in the afternoon that he may be wheeled out to see a new consignment of owls just arrived from Finland, and writes from his sick room to a friend who had been near a rock reputed to be the home of a reptile to be found nowhere else, without having been able to land, "I would have seen those lizards or known the reason why," is the child who, half-a-century before, had begged his mother to let him bring home in a band-box a lizard caught at Holland House, where they had been calling, and had jumped up from his first whipping for some infantine offence with "It didn't hurt very much! Look! There is a brown owl flying by!"

"E'en in our ashes live their wonted fires."

Like Edward, the Banff shoemaker—his counterpart in a humbler sphere—Lord Lilford was a born naturalist. The two men—wide as they stood apart on the social ladder—had much beside a Christian name in common. The "ruling passion" which made the ragged urchin Tom Edwards carry the wasp's nest to school tied up in his shirt and earned him many "skelpings" for frightening his mother and her neighbours by bringing home "puddocks," horse-leeches and other "venomous critters" was the same that led Tom Powys to smuggle little bitterns into his Harrow study and brought tears into the eyes of the "Irish Slavey" in Half Moon Street when the armadillos brought home in a four-wheeled cab by the gentleman lodger—"scaly beasts"—killed her cat.

A new or rare bird had the same magic power on both. The sight could charm the one into unconsciousness of gout and helplessness, and make the other forget the pinch of hunger and empty pockets.

It is for its aviaries that Lilford Hall is best known to readers of NATURE. Of these—at one time among the most extensive and best cared for in England, perhaps in Europe—a very interesting description is given in a presidential address to the Northamptonshire Field Club delivered by the owner in 1894 and now reprinted in Mr. Trevor Battye's book.

Like most carefully thought-out things, they were of slow growth. Lord Lilford had kept birds from childhood, and in Christ Church days was already able to send Prof. Newton an imposing list of his possessions. But it was not until later that he began collecting in earnest.

"I have only gone in for a large and serious collection," he wrote the year before his death in a touchingly apologetic letter to a lady who had apparently expressed her views on keeping birds in confinement, "since I became crippled and, therefore, could not see birds elsewhere than at home."

He was always ready to give from his stock to help the acclimatisation of a new or reestablishment of a vanishing bird.

In 1872, he wrote to Lord Walsingham, at the time personally unknown to him, offering a present of twenty brace of Virginian colins to be turned out at Merton, where, as he thought, the country should exactly suit them. A few years later, at first one, and after that a second, hen great bustard was sent to the same neighbourhood in the hope of inducing a fine old cock who had appeared on a fen near Thetford to set up house again in an old favourite home of the family. Unluckily, the experiment was not successful.

"When the great bustard honoured me with its visit," writes Mr. Upcher, on whose property the bird had established itself, "Lilford, in his desire to reestablish them in the country, sent me a female from his aviaries. I kept a man watching night and day lest some conscienceless collector should come on the prowl. He reported that they seemed to get quite fond of one another and he verily believed almost touched. Then, alas! came an out-of-season snowstorm and the poor hen succumbed. Lilford, in his generosity, sent another lady, but my lord did not approve of the change and departed, getting safely out of the country."

On almost every page of Lord Lilford's notes are to be found texts on which sermons on natural history might be written. But these and the journals of yachting trips

and ornithological rambles on the plains and mountains of Spain or among Mediterranean islands, full as they are of pleasant suggestions, and other matters of equal interest—his views on protective legislation, among others—must be left unnoticed, if only to leave a corner for the charming little word pictures painted for the guidance of Mr. Thorburn when drawing the pictures for Lord Lilford's last beautiful work, "Coloured Figures of the British Birds."

"Monumentum ære perennius."

The following are specimens taken at random. All are equally good.

The first is for the picture of the storm petrel, the second for the puffin.

"It would perhaps be best to make him skimming the water with legs at their full length and toes extended; in fact, running on the water with wings extended. What I want to try to get is the very striking effect of these little black birds against a deep blue ocean sea and foam."

"A group in full summer dress on steep slope of short turf over sea. Cliff honeycombed with burrows—rabbits, sea pinks."

The only objection to be taken to Mr. Trevor Battye's work as editor of Lord Lilford's papers, which is excellently done, is that his book is rather too patchworky to be read smoothly as a whole. The fault, if fault it is, is, perhaps, in view of the nature of his materials, one which could not have been altogether avoided.

A book of extracts, however carefully chosen, is like the kinematograph. Unless very skilfully managed, the effect is apt to be a little spoilt by jolts and jerks as the moving pictures succeed one another. Mr. Trevor Battye, some readers may think, has gone out of his way to drop pebbles into the machinery by inserting, as integral parts of the book, articles on hawking and on otter hunting by other pens, between two sections of Lord Lilford's own writings, to neither of which has either article any special relation.

That both papers are charming in themselves and well worth reading does not necessarily imply that they are good where they appear. Dirt, as someone once defined it, is "good matter misplaced"; but none the less it is better away.

Another small criticism, to satisfy Mr. Trevor Battye that all he has written has been thought worth reading carefully. On p. 144, he says Lord Lilford's preference for wild pheasants was owing to "the instinctive and *unsportsmanlike* shrinking from the idea of the non-natural culture of the pheasant." Is not *sportsmanlike* the word he had intended to write?

One good story, which, as Lord Lilford tells us, "amused" him "vastly at the time," and this rambling notice must end. A visitor to Lilford, who evidently took a great interest in the birds, was just leaving when he suddenly turned to his conductor and said, "By the way, I saw in the paper some time ago that Lord Lilford had given a very long price for an egg of the great auk. I trust that he was successful in hatching it?"

Mr. Thorburn's pictures are, as usual, delightful.

T. DIGBY PIGOTT.

THE PRINCIPLES OF TEACHING.

Principles of Class Teaching. By J. J. Findlay, M.A., Head Master of the Cardiff Intermediate School for Boys. Pp. xxxvi + 442. (London: Macmillan and Co., Ltd., 1902.) Price 5s.

IT is a wholesome sign of our times that so many attempts are being made by experts in education to find a scientific basis for the procedure and organisation of schools. Within the teacher's profession, and outside of it, there is a growing conviction that education is a science and not merely an art or even a fine art, but that its practitioners are bound to investigate the *rationale* of their methods, and the philosophy which underlies and justifies all really effective rules of practice. Mr. Findlay's book is an honest and successful effort in this direction. He has somewhat needlessly, as we think, restricted the aim and the possible usefulness of his work by calling it the "Principles of *Class* Teaching," Teaching in a class is, after all, teaching under one particular set of conditions, whereas the principles of teaching, the art of communicating, the relative values of different kinds of knowledge, the fitness of certain subjects for scholars at different stages of development, and the influence of different studies and forms of intellectual discipline on the formation of the tastes and the moral character, are matters of large and universal interest which deserve consideration in their relation to teaching under all conceivable conditions, whether learners are taught in a class or not. To do Mr. Findlay justice, these are topics which he has not overlooked, but which are handled incidentally and often with considerable acumen and judgment in the course of his treatise. The book is, in fact, what its title professes, and something more.

At the outset, the author discusses the constitution of a class and the number which should be found in it. He says that

"A teacher of experience will usually be willing to handle a class of thirty pupils, if the thirty are fairly equal in attainments; he would be unwilling to go up to forty or to fall below twenty."

But, in fact, no such general rule as this is of much practical value. The number of scholars in a class should depend largely on the nature of the subject to be taught. For a construing lesson, for one in which constant appeal is needed to individual scholars and for close intellectual intercourse between teacher and taught, the number should be small; while for certain forms of collective teaching, for demonstrations, for music lessons, for the use of pictorial or other illustrations, for telling a story and for moral and hortative lessons, in which what David Stow called the "sympathy of numbers" has to be invoked, the numbers in a class might well be larger. But, as Mr. Findlay justly says:—

"The unit in education is not the school or the class, but the single pupil. However fruitful it may be to discuss the 'psychology of the crowd,' whether in school or in the streets, the value of the study depends upon our previous acquaintance with single individuals."

The most serviceable and suggestive part of the book is that which deals with the curriculum of instruction in schools of different types, from the kindergarten to the

high school and the college. Except that the author has burdened himself needlessly with the Herbartian terminology, which often tends to obscure what for plain and uninitiated readers might easily have been treated more simply, there is little but praise to be given to the manner in which the book discusses in detail the numerous topics which come under review. For example, in treating of early and infant education, Mr. Findlay analyses with much ingenuity and force the true meaning of Fröbel's teaching, and helps the reader to distinguish between the essential verity which underlies that teaching and the travesty of it, which too often satisfies the merely mechanical kindergarten instructor. He shows that

"The final value of Fröbel, as of his master Pestalozzi, is to be found rather in the spirit of his work than in the particular devices he employed." "Instead," he says, "of the tedious and useless paper-folding 'occupations,' which are a part of the Fröbel fetish, we may find it possible even with little children to cultivate the decorative art; they may trace the snowdrop pattern on flannel or cardboard, and then cut it out to stitch or paste on to darker material serving thus as a rug or tablecloth to please mother at home, as something of service to her. Taste on the teacher's part quickly develops appreciation for simple forms of beauty."

In like manner, this book shows how easy it is for even the best theories of enthusiasts to degenerate into formalism and pedantry, unless the nature of child-life and the possibilities of intellectual development are looked at with fresh eyes, and unless teachers can emancipate themselves from traditional methods. This is well illustrated by the chapters in which the claims of the humanities are examined both in their relation to later childhood and to more advanced stages of progress. At first, "Robinson Crusoe" and the "Odyssey," "Tales of Greek Mythology," the story of Joseph and his brethren and that of King Alfred are cited as examples of narratives which are likely to touch the imagination and arouse the sympathy of the learner none the less because they are remote from his present environment and experience. They

"bring family relations into prominence. Odysseus never forgets Ithaca; the tragedy of Joseph's life centres round his father's home. The child is still a home-bird, and in the humanities, above all, this sentiment must find a place right through into boyhood."

On the subject of teaching science, Mr. Findlay rightly insists on the importance of such preliminary training as may awaken the faculty of observation and kindle in the pupil an interest in the phenomena of the visible world before proceeding to the technicalities of science as generally understood in schools. The true scope and meaning of "Nature-study" as a means of giving the basis of ideas and experience on which formal lessons on science may hereafter be wisely built are thought out and explained with much care.

Throughout the book, the author shows himself to be a faithful disciple of Herbart, and enforces in various ways the need of kindling interest and securing the co-operation of the scholars in the business of learning:

"The child is supremely an active being, and it must be the teacher's care, not only to provide suitable material for thought, but for action. Hence, in our scheme of a curriculum we shall recognise the arts and occupations of the young in drawing, in music, in games, in manual training, as worthy to take rank side by side with those branches of knowledge which, since the Renaissance, have sought to usurp the whole field. In so doing, we shall be simply reverting to the older and more generous method of the Greeks."

Space forbids further detailed reference to the ways in which the author has sought to illuminate the path of the teacher and to define his aims. There are some disputable propositions in the book, and good teachers will not be unanimous in approval of all the methods recommended. But it will suffice here to say that the author's effort to find a rational explanation of the best practical and professional rules has been successful and that the book will take rank among the most thoughtful contributions to educational science which have appeared in recent years.

J. G. F.

A WORK ON SURVEYING.

Surveying, as Practised by Civil Engineers and Surveyors, Including the Setting-out of Works for Construction and Surveys Abroad, with Examples taken from Actual Practice. By John Whitelaw, jun. Pp. xiv + 516. (London: Crosby Lockwood and Son, 1902.)

THIS book cannot be considered altogether satisfactory or as fulfilling the purpose the author proposes to himself. One gathers from the short preface that it is his intention to present a useful text-book of principles and methods for students, as well as a guide to the actual practice of surveyors and civil engineers in the various branches of surveying. This is a sufficiently ambitious programme, and for its successful accomplishment it demands, not only a practical training in the field, but some facility of mathematical manipulation, since there must be constant reference, not only to the methods and details of actual measurement required for various practical purposes, but to the theory of instruments, the application of the theory of errors, geodetic problems and the principles involved in hydrographic surveying.

Up to a certain point, we have the greatest confidence in our author. Wherever he is describing work of which he has had actual experience, he is a welcome guide. In various commercial undertakings, such as the preparation for railroads, or waterworks, there is abundant evidence that his work is competent and trustworthy; but to write a book on the lines proposed, more is needed than familiarity with practical surveying within a limited area. One begins to lose confidence when he reads what the author calls the theory of the sextant, but which is limited to the demonstration of an elementary proposition in geometrical optics. It is true, at a later stage the author gives rules for the practical adjustment of the sextant, but such ordinary matters as the errors produced by a prismatic form of the index glass, or by the inclination of the index or horizon glass are either entirely ignored or not brought before the student with the necessary detail.

This confidence sinks still lower when we get a rule for the determination of the probable error from two

observations only. One feels that the theory of errors has not been grasped with a complete mastery. After glancing at such uncomfortable-looking formulæ as $BC' = d \tan (BAC + 0{\cdot}000069\,d)$ and wondering whether there is any advantage in such forms of expression as cos. of co-dec., in place of the more familiar Sin. dec., we turn to the section on longitude determination to learn how the method is practised by civil engineers and surveyors. And in this chapter one learns some strange things. It does not appear to be at all necessary to take into account the parallax of the moon in the method by lunar distances, and the problem of "clearing the distance," a problem fraught with much pain and anxiety to many, does not seem to trouble engineers and surveyors. Similarly, the longitude by lunar occultations is treated with equal lightness and brevity. We are told that the Greenwich mean times of the occultations of fixed stars by the moon are given in the *Nautical Almanac* for both immersion and emersion, and that by applying the approximate longitude in time, the approximate local mean time of the occultation may be found, and the observer will know approximately when to begin to observe. We recommend the two or three pages of explanation of the section "Elements of Occultation" given at the end of the *Nautical Almanac* to the author's attention.

These remarks are not made in any unkind spirit, but, if possible, to warn the student to what extent he may trust his author. We can readily believe that with his chain and his theodolite, the writer of the book has done, and will continue to do, good work, and if he had been content to describe accurately what he knew thoroughly, he would have given us a valuable practical treatise. But he has ventured on subjects of which his experience has not qualified him to treat, and in these directions we can neither follow him with satisfaction nor unreservedly recommend his book to the careful study of the large class of students who might have profited by it.

W. E. P.

PROTOZOAN NATURAL HISTORY.

Faune Infusorienne des Eaux stagnantes des Environs de Genève. Par Dr. Jean Roux, Assistant au Laboratoire de Zoologie de l'Université de Genève. Pp. 148; 8 plates. (Genève: H. Kundig, 1901.)

Faune Rhizopodique du Bassin du Léman. Par Dr. Eugène Penard. Pp. 714. (Genève: H. Kundig, 1902.)

THE systematic study of the natural history of the Protozoa in past years has, in general, lagged far behind that of the higher groups of animals. In large part, no doubt, this has been due to technical difficulties of collection and examination, but it has resulted also from a delay in recognition of the fact that the same problems of species and of their geographical distribution which have stimulated and directed the detailed study of Metazoan natural history for so many years have equivalent applicability and interest among the Protozoa. The brilliant labours of Ehrenberg, however, who concerned himself largely with the local distribution of Protozoan forms, and the later work of Bütschli, have been increasingly fruitful. The conception by Bütschli of the "cosmopolitanism" of the Protozoa has been supported by the results of numerous workers in various countries and continents, and found its fullest sanction in the studies of Schewiakoff during his voyage round the world. Schewiakoff, indeed, by showing in how large a proportion the Protozoan species already well known in Europe were spread through other continents, opened the most attractive field for the study of the problem of species among the unicellular animals.

The two valuable monographs we now owe to Drs. Roux and Penard will rank high among the later contributions to the Protozoan natural history. Concerned as they are with the exact description of a purely local fauna, they may be considered to be in a sense complementary to the extensive researches of Schewiakoff—they have a value which is intensive, rather. With the general idea of Protozoan ubiquity and specific "cosmopolitanism" well grounded, we may hope that by the sufficient accumulation of exact local studies, and perhaps in no other way, we may eventually see unravelled the intricate relationships of nutritive conditions and of the environment in general, not only to secondary body characters, but to the processes of fission and its secondary developments, which determine to so large a degree the life-histories of the Protozoa. Not the morphologist alone, but the physiologist too, will welcome the advances of our knowledge in this direction, for the latter must hope to gain a widely increased outlook upon the significance and origin of many cellular processes by the determination of the phylogenetic relationships among groups of Protozoa.

Dr. Jean Roux has collected, identified and described in detail the species of Infusoria occurring in the stagnant waters, in pools, marshes and basins in the neighbourhood of Geneva. His work gives fresh verification, if any were required, to the very generalised distribution of Protozoa throughout the world, for he has already found in his own district three-fifths of all the forms of non-marine Infusoria which have been described for other countries. His arrangement of the species follows Bütschli's classification, except in the order Holotricha, in which the divisions of Schewiakoff are adopted. Very complete systematic descriptions are given of every form, the arrangement and shape of its organs, its characteristic movements, and, in most cases, its normal *habitat* and mode of nutrition.

The text is illustrated by well executed coloured plates, which give figures, drawn by the author, of about 170 species. Some interesting points are raised by Dr. Roux in connection with the seasonal changes of population among the Infusoria. Statistical inquiry has shown that the population of a given species exhibits maxima and minima of seasonal incidence. In general, a maximal population is found both in spring and autumn, a fact which has not yet received adequate explanation. These two maxima may be real; they may be due to increased reproductive activity both in preparation for, and in con-

sequence of, the encystment or quietude of the winter, or they may result from an improved food supply dependent upon similar seasonal maxima in the population of Algæ and Diatoms. The maxima, on the other hand, may be only apparent, and exhibited relatively only to a summer minimum which may be supposed to coincide with the maximal development of the natural enemies of the Infusoria, such as the crustacean Cyclops and the like. These difficulties of explanation may be taken to represent only one set out of many problems in natural history which the systematic study of these lowly forms is likely to suggest.

The appearance of Dr. Penard's companion monograph upon the Rhizopod forms of the same locality is very aptly timed. It contains the results of his laborious researches into the very numerous and often ill-defined species of this large group, with the fullest systematic descriptions of their structure and habits, and it is abundantly illustrated throughout with accurate drawings. The author has not included among the Rhizopoda the group Heliozoa, generally, but not very suitably, associated with them. Dr. Penard has already published studies of the Rhizopoda he has found elsewhere in Europe and in North America, and it is significant, in connection with what has been said above, that in his collections of purely local forms in the Genevan district he finds represented no less than 92 per cent. of the species which have been described for the whole world, although he has added a few hitherto undescribed species to the list. In this estimate, he does not include, it should be said, those forms of the Amœba class which are entirely devoid of skeleton and less easily defined or identifiable. The volume contains a large bibliography, and indices both to the subject-matter and to the species described.

In addition to the systematic description of the Rhizopod fauna, Dr. Penard gives a series of separate essays upon special points of interest in their general morphology and behaviour—he deals with their growth, the skeleton and its appendages, with the plasma, its inclusions and pseudopodia, the nucleus, the contractile vacuole, and finally with general questions of geographical distribution, reproduction and hybridity. The most important variations of the shape and disposition of the nucleus throughout the group are described and figured, and these are strikingly numerous and diversified. The author does not, however, give any systematic account of the distribution within the Rhizopoda of the chief Protozoan types of nuclear division. It has already been shown by Schewiakoff and others that complexity in the process of karyokinetic nuclear division is by no means exhibited only by the more highly organised forms among the Protozoa, and a good deal of light might be expected to be thrown upon the relationships between cellular elaboration and the karyokinetic figure by a systematic examination of the nuclear behaviour throughout the species of one group. Much no doubt remains to be done, but Dr. Roux and Dr. Penard are to be congratulated alike upon very notable achievements of skill and industry. Their labours have borne fruit already, and will long, we believe, remain profitable to fellow-workers in the same field.

A NEW ATLAS OF THE ATLANTIC OCEAN.

Atlantische Ozean. Ein Atlas von 39 Karten, die physikalischen Verhältnisse und die Verkehrs-strassen darstellend. Zweite Auflage. Herausgegeben von der Direktion. Deutsche Seewarte. (Hamburg: L. Friederichsen und Co., 1902.)

TOWARDS the end of the year 1898, the Deutsche Seewarte published the second edition of its well-known "Segelhandbuch" for the Atlantic Ocean, but it was regretted at the time by the director, Prof. Neumayer, that a new edition of the atlas was not forthcoming. There were, however, very good grounds for its non-appearance, since it was considered that there was not sufficient new material available to make it worth while undertaking such a large piece of work.

During the many years that have now elapsed since the first edition of this atlas was published, a very considerable amount of valuable information has been accumulated, and advantage is now taken to bring the atlas up to date and to make it complete and trustworthy as regards every piece of information it conveys.

Among some of the sources of the new data which have been embodied in the work is that of the valuable series of observations made by the *Valdivia.* Further, advantage has been taken of another large piece of work which has recently been brought to a conclusion, namely, the ten-degree square investigation of the North Atlantic; these observations covered a zone extending from 20° to 50° north latitude and stretching from the west of Europe to the east of North America, and they have been published recently in no less than nineteen volumes.

Another store of valuable data was also ready at hand, namely, that which had been collected by the Deutsche Seewarte in connection with the Danish Meteorological Institute and utilised for making its synoptic weather charts. The work also of our own Meteorological Office and Hydrographic Department has also been usefully employed on many occasions, and especially to fill up gaps not covered by German observations.

It will be seen that there was no lack of good material, and Prof. Neumayer has so marshalled his facts that he has been able to present seafaring men and meteorologists with a trustworthy series of maps which illustrate our present knowledge of the mean physical and hydrographical conditions of this important region of the world.

The thirty-nine maps that compose this atlas are accompanied by clear explanatory remarks which describe their mode of construction and include the sources of all the data that are contained in them.

In a brief notice, it is not possible or even necessary to describe each of the maps in this atlas, but it will suffice to remark that they are arranged, not only to give the mean meteorological, hydrographical, &c., condition for the year, but the mean, in many cases, for important individual months or groups of months.

Thus, for instance, in the case of barometric pressure, we have a chart showing the mean isobars of the Atlantic Ocean for the whole year and four maps for

the four months February, May, August and November, and also mean monthly charts of the North Atlantic for each month, showing the pressures for every five-degree square.

Not only do the charts give information on the numerous meteorological elements such as temperature, wind tracks of storms, rain, &c., but they refer to the depths, temperature at different depths, specific gravity, currents, &c., of the water in this ocean, the magnetic elements for the year 1902, mean ship routes for two seasons of the year, and the distribution and chief hunting grounds of the most important species of whales.

A word further may be said in praise of the reproduction of the maps, which are all neatly and distinctly coloured, and on scales which are sufficiently large for the purposes for which they are intended.

Both the distinguished director of the Deutsche Seewarte and his co-workers are to be congratulated on the completion of this important work, and for their successful efforts in bringing before the world in such a concise form the results of so many observations. British meteorologists and sailors will certainly find this work of great utility, and they, like the present writer, will no doubt appreciate the service that has been rendered by their German confrères at the Seewarte.

W. J. S. L.

THE WANDERINGS OF A NATURALIST.

Aus den Wanderjahren eines Naturforschers, Reisen und Forschungen in Afrika, Asien und Amerika, nebst daran anknüpfenden meist ornithologischen Studien. Von Ernst Hartert. Pp. xiii + 329. (Berlin: Friedlander und Sohn; London: Porter, 1901–2.)

A SHORT time ago (NATURE, vol. lxiv. p. 249, July 11, 1901), we called attention to the scientific work carried on at the Tring Museum and to its excellent results as regards the advancement of zoology. In *Novitates Zoologicae*, the organ of that institution, has been lately published a series of articles written by Mr. Ernst Hartert (one of Mr. Rothschild's staff of naturalists, whose name is well known to all zoologists), containing an account of the various expeditions which he has made, in the intervals of a very busy life, to the tropics of three continents. These articles are reprinted in the volume now before us, and are accompanied by some excellent illustrations.

Before noticing this work, we may express some regret that Mr. Hartert did not write it in English, with which language, we believe, he is quite as familiar as with his native tongue. All educated Germans can read English; but it is a fact, we regret to say, that many highly educated Englishmen do not read German with facility, although they may be able to comprehend its general meaning. By writing in English, we believe, Mr. Hartert would have secured a much larger number of readers for his interesting narrative.

Mr. Hartert is so fortunate as to have visited the tropics of Africa, Asia and America in the course of his wanderings—a feat which we suppose few other naturalists have achieved. In April, 1885, he left Hamburg as a volunteer zoologist in company with Flegel's Niger-Benué Expedition, to an account of which the first section of this work is devoted. From Loko, on the Benué, a successful journey to Sokoto and Kano was made across Hausaland, but the talented leader of the expedition lost his life on the way back and others were very sick. Various zoological notes will be found in the text of the narrative of this excursion, and special chapters on the birds of the Canary Islands and of Hausaland are added.

In August, 1887, our author turned his face to a very different part of the earth's surface, and started for Penang and Sumatra, with the object of making entomological collections for the late Dr. Richter's cabinets. The journey was subsequently extended to the attractive island of Salanga, on the coast of the Malay Peninsula, and to the British Protectorate of Perak, where both fauna and flora seem to be of the richest and most varied character. An account of these journeyings, interspersed with zoological notes, and of the return home through British India occupies the second section of our "Naturalist's Wanderings." Special chapters are devoted to an annotated list of the birds of Deli, in Sumatra, where examples of 212 species were met with. In this exuberant avifauna, the hornbills, of which no less than nine species are enumerated, must form an attractive feature.

In the third section of his journal, Mr. Hartert takes us across the Atlantic, and tells us of Venezuela and its islands, which he visited in 1892, accompanied by his wife, who, we have been informed, is an accomplished collector of birds and insects. The principal exploit of the journey was the complete ornithological exploration of the three Dutch Caribbee Islands of Curaçao, Aruba and Bonaire off the coast of Venezuela, of which very little was previously known. Mr. Hartert published his account of this excellent piece of work in the *Ibis* for 1893. He now adds many details about his adventures and experiences of all kinds. He has come to the conclusion—no doubt correct—that, though many West Indian forms are represented in Curaçao and "its satellites," the greater part of their fauna has been acquired from the neighbouring continent.

In the fourth and concluding section of his volume, the author takes us back to Africa, not, however, to the fever-stricken banks of the Niger, but to the wholesome and charming sea-board of Morocco, which, according to Hooker and Ball, will ultimately become one of the finest winter-resorts of the Eastern Hemisphere. It is remarkable that a fresh and wild land so easily accessible to Europeans is not more frequented. Mr. Hartert descants fully upon the birds met with in the vicinity of Mazagan, whence he crossed the sea to Teneriffe and returned home by Madeira.

AN ASPIRING GLACIALIST.

The Cause of the Glacial Period. By H. L. True, M.D. Pp. 162. (Cincinnati: Robert Clarke Company, 1902.)

GEOLOGISTS and physicists have been at their wits' end to discover the cause of the Glacial period. They may now cease from cudgelling their brains—Dr. True, of McConnelsville, O., has finally solved the mystery. The explanation is so simple that all who have meddled

with the question must be chagrined to think that a solution so obvious should have escaped them. The author tells us that when he

"first began to read on this subject, he had a preconceived opinion of the cause, which to him seemed so reasonable that he wondered why others had not come to the same conclusion."

Ah, but that is always the way! It is only after the riddle is solved that it seems so simple—but the apparent simplicity of the solution should not detract from the merit of its perspicacious discoverer.

We give, in a few words, Dr. True's inspired "theory":— Up to and during part of the Tertiary period, the earth had so far cooled and the crust had become so thickened that it was just able to support itself.

"But finally the point was reached when it could sustain it (the pressure) no longer. The last grain of sand broke the camel's back."

Suddenly the floor of the ocean settled down, while the mighty north and south mountain ranges of the globe were ridged up. Concurrently with these movements, the polar regions were elevated into dry land, and their supply of warm water from the south being cut off, the formation of ice-fields forthwith began and finally culminated in the Glacial period. The Arctic lands then existed as plateaus—miles in height—an amount of elevation

"amply sufficient to produce almost any degree of cold, and also a slope extending several hundred miles, sufficient to account for the motion of the ice in a southerly direction. Here is where the northern elevation, which nearly all geologists say must have accompanied the Glacial period, comes in. The great wonder is that they have not seen what caused it."

It is needless to say that under such conditions the ice continued to accumulate until not only all N. Europe and N. America, "but the whole bottom of the N. Atlantic, as far south as the southern border of the telegraph plateau," were covered with an ice-sheet. While this mighty ice-sheet overwhelmed those regions, N. Asia escaped glaciation. Why? Simply because it was deeply submerged at the time, and so the polar ice advancing southwards broke off in icebergs and floated over north and south Siberia. The withdrawal of so much water from the ocean and the piling of it up in the form of ice on the western hemisphere naturally disturbed the earth's equilibrium. We should not be surprised, therefore, to learn that all of a sudden the earth "tipped" or "toppled over," in order to bring about "a readjustment of matter to the stationary axis."

"N. America and W. Europe moved down out of the cold region, while N. Siberia, on the opposite side of the earth, moved up into it."

Of course, these changes produced a cataclysm—"great tidal waves, perhaps miles in height," sweeping the ice-sheet out of the N. Atlantic and flooding much of the continents.

And so the Glacial period came to an end in N America and Europe. But, as our author remarks,

"it is plain that when the west side of the earth warmed up, the east side became cold, and it is also plain that the transition was sudden."

This is shown by the admirable preservation in N. Siberia of the carcasses of mammoths and woolly rhinoceroses—"the congeners of those now inhabiting a tropical climate."

"It seems that when the east side of the earth tipped northward, the reaction caused a great tidal wave that caught the animals which roamed over the regions south of and adjacent to the then northern ocean, and carried them away as drift, to become frozen in ice, and there they have remained ever since."

Who will not sympathise with glacialists? Their occupation, alas! is gone; no more difficulties are left for them to encounter; with a wave of his magic pen, our inspired doctor has banished darkness and laid bare every secret of the Ice Age. He knows the past of our globe so well that one cannot wonder he should be equally confident as to its future. His theory is a true "open sesame." The same succession of remarkable changes which he has unveiled for us will, we are assured, again supervene; and his readers may well shiver and shudder at the "gloomy picture" he presents for their contemplation. They are advised, however, by the considerate author not to be "uneasy" because of that dismal future—it is still a long way ahead. "They will not be here when it comes." J. G.

PROPERTIES OF MATTER.

A Text-Book of Physics. By J. H. Poynting, Sc.D., F.R.S. and J. J. Thomson, M.A., F.R.S. Properties of Matter. Pp. vi+228. (London: C. Griffin and Co., Ltd., 1902.)

THIS volume is to be regarded as the opening one of a series forming a text-book of physics, of which the second part, namely, "Sound," was published some two years ago and is now in its second edition. The remaining volumes, dealing with "Heat," "Magnetism and Electricity," and "Light," will be published in succession, it may be hoped at somewhat shorter intervals.

The book is not intended for elementary students on the one hand or for mathematicians on the other, and the authors make a welcome innovation in entirely omitting the more purely mathematical side of mechanics with which text-books on the properties of matter are usually encumbered. After a brief preliminary chapter dealing with the experimental evidence for the constancy of weight and mass, about fifty pages are devoted to a most interesting and complete account of the experimental work on the measurement of the acceleration of gravity, the figure of the earth and the constant of gravitation, introducing the student to a number of most instructive physical methods, described with the discrimination of a practised experimentalist who has made a special study of the subject. The next seven chapters (60 pp.) deal with the elasticity of solids from an experimental standpoint, mathematics being introduced only so far as is necessary to permit a comparison of theory and observation in a few simple cases, which serve to illustrate the physical principles involved. Many comparatively recent experiments are described, such as those of Ewing on the yielding of crystalline substances by slipping along the cleavage planes. The remainder of

the book deals with the compressibility of liquids and gases, and the phenomena of capillarity, diffusion and viscosity. In discussing these subjects, the molecular theory of matter has of necessity been very freely introduced, but the detailed account of the theory has been reserved for the volume on heat. Among the subjects incidentally discussed in the present volume are Van der Waals's equation for the relation between the pressure and the volume of a gas, reversible thermal effects accompanying alterations in strains, effect of temperature on surface tension, change of vapour-pressure under stress, osmotic pressure, vapour-pressure of solutions, lowering[1] of the boiling point of solutions, lowering of the freezing point of solutions, variation of viscosity with temperature, and explanation of viscosity and diffusion on the kinetic theory. An elementary knowledge of heat may reasonably be expected of the student, but it would seem preferable to have reserved some of these subjects until the kinetic theory and the second law of thermodynamics had been discussed.

It is hardly necessary to say that the book is of a thoroughly practical character, and will commend itself both to the teacher and the student. The book is written from the point of view of the experimental physicist, and the subjects selected for illustration are those most useful and instructive to the student. The mathematical methods employed are generally of a simple character. In many cases, these may appear cumbrous and difficult to the student who possesses a knowledge of more advanced mathematical methods. But even for such fortunate students, there is some compensation in the fact that the more elementary method compels attention to the physical meaning of the processes employed. In the case of many of the subjects discussed, it would be difficult for the student to find an equally concise and clear account of the theory and the experimental methods in any other book at present accessible, and we are confident that the present volume will be found to be a useful addition to the text-books available for advanced students of physics.

H. L. C.

ZITTEL'S TEXT-BOOK OF PALÆONTOLOGY.

Text-book of Palaeontology. By Karl A. von Zittel. Translated and edited by Charles R. Eastman. Vol. ii. Pp. viii + 283. (London: Macmillan and Co., Ltd., 1902.) Price 10*s.* net.

NEARLY three years have elapsed since we received the first volume of the English edition of Prof. Karl A. von Zittel's well-known "Grundzüge der Palæontologie." We therefore open the newly published second volume with some fear lest the long delay in its production be due to a complete remodelling, such as that which we criticised on the last occasion. This new nstalment, however, is a welcome surprise; for, while the sections with which it deals have been judiciously edited and somewhat brought up to date, the author's original plan is strictly followed, and it still remains essentially the work of the Munich professor.

[1] This is evidently a misprint for "raising of the boiling point," which is the term used near the end of the section, but the sign of the change is not clearly brought out in the analysis.

The present volume deals with Pisces, Amphibia, Reptilia and Aves, and extends only to 278 pages—a slight increase on the original text from which it is translated. The Mammalia will form a third and concluding volume, to be issued later. This plan of subdividing the text-book into instalments of convenient size for ready reference will be appreciated by all who have been compelled to use the ponderous German edition, which is a volume much too bulky for comfortable handling.

The section on Pisces, occupying 114 pages, has been translated and revised by Dr. Smith Woodward. The author's original classification has only been slightly modified to incorporate Dr. Traquair's recent descriptions of Upper Silurian and Lower Devonian fishes, and the translator's own observations on the Pycnodonts and some of the Teleosteans. These changes are evidently approved by Dr. von Zittel himself. Traquair's figures of Drepanaspis, Birkenia and Lasanius appear for the first time in a text-book and his remarkable discoveries are now made accessible to an elementary student. The revised account of the Teleostei is also the first condensed synopsis of recent discoveries which has been published in a general treatise.

The section on Amphibia, occupying twenty-five pages, has been translated and revised by Dr. E. C. Case. There are no new figures, and the changes consist merely in a few allusions to recent discoveries.

The revision of the section on Reptilia, now occupying 116 pages, was begun by the late George Baur, whose untimely death prevented his accomplishing more than part of the chapter on Chelonia. Most of the present translation has been done by Dr. E. C. Case. The chapters on Squamata and Pterosauria have been revised and extended by Prof. S. W. Williston, who has also contributed notes on Plesiosauria and Chelonia. The chapter on Dinosauria has been brought up to date by Prof. H. F. Osborn, Dr. O. P. Hay and Mr. J. B. Hatcher. Dr. Case himself appears to be responsible for the removal of the Clepsydropidæ from the Theromorpha to the Rhynchocephalia. The revision, on the whole, is a distinct improvement on the original work. The supplementary details concerning the fossil reptiles, especially of North America, will prove very useful for reference; while a few new figures of restorations by Williston, Smith Woodward and Hatcher add to the educational value of the book.

The section on Aves has been doubled in extent by Mr. F. A. Lucas and now occupies twenty-three pages. No new figures are given, but the text is well up to date, and it is especially valuable as being a critical summary combined with original observations.

The volume concludes with a good index to the names of genera, and forms the most exhaustive work of reference on the extinct cold-blooded vertebrates and birds which has hitherto been published in the English language. Dr. Eastman and his colleagues are, indeed, to be congratulated on the successful completion of this new instalment of their undertaking, which will prove of the greatest service to all English-speaking students both of geology and zoology.

THURSDAY, FEBRUARY 12, 1903.

THE SCIENTIFIC WORK OF SIR GEORGE STOKES.

STOKES ranged over the whole domain of natural philosophy in his work and thought ; just one field —electricity—he looked upon from outside, scarcely entering it. Hydrodynamics, elasticity of solids and fluids, wave-motion in elastic solids and fluids, were all exhaustively treated by his powerful and unerring mathematics.

Even pure mathematics of a highly transcendental kind has been enriched by his penetrating genius ; witness his paper "On the Numerical Calculation of a Class of Definite Integrals and Infinite Series,"[1] called forth by Airy's admirable paper on the intensity of light in the neighbourhood of a caustic, practically the theory of the rainbow. Prof. Miller had succeeded in observing thirty out of an endless series of dark bands in a series of spurious rainbows for the determination of which Airy had given a transcendental equation, and had calculated, of necessity most laboriously, by aid of ten-figure logarithms, results giving only two of those black bands. Stokes, by mathematical supersubtlety, transformed Airy's integral into a form by which the light at any point of any of those thirty bands, and any desired greater number of them, could be calculated with but little labour and with greater and greater ease for the more and more distant places where Airy's direct formula became more and more impracticably laborious. He actually calculated fifty of the roots, giving the positions of twenty black bands beyond the thirty seen by Miller.

With Stokes, mathematics was the servant and assistant, not the master. His guiding star in science, was natural philosophy. Sound, light, radiant heat, chemistry, were his fields of labour, which he cultivated by studying properties of matter, with the aid of experimental and mathematical investigation.

His earliest published papers [Cambridge Philosophical Society, April 25, 1842, and May 29, 1843, followed (November 3, 1846) by a Supplement] were on fluid motion ; the second of these and its supplement contained a beautiful mathematical solution of the problem of finding the motion of an incompressible fluid in the interior of a rectangular box to which is given any motion whatever, starting from rest with the contained liquid at rest. This solution, as shown in Thomson and Tait's "Natural Philosophy," §§ 704 and 707, is also applicable to the very practical problem of finding the torsional rigidity of a rectangular bar of metal or glass. For every oblong rectangular section, the solution may be put in one or other of two interestingly different forms, which are identical when the cross-section is square and are always both convergent. One of them converges much more rapidly than the other when one of the diameters of cross-section is more than two or three times the other. Regarding these two solutions, Thomson and Tait (§ 707) say :—

"The comparison of the results gives astonishing theorems of pure mathematics, such as rarely fall to the lot of those mathematicians who confine themselves to pure analysis or geometry, instead of allowing themselves to be led into the rich and beautiful fields of mathematical truth which lie in the way of physical research."

The 1843 paper contained his theory of the viscosity of fluids ; and his definite mathematical equations for its influence in fluid motion, which constitute the complete foundation of the hydrokinetics of the present day. In the same paper, by reference to known facts, relating to natural and artificial solids, glass, iron, india-rubber, jelly, and results of experimental investigations, he relieved the theory of elastic solids from what is now known as the Navier-Poisson doctrine of a constant proportion between the moduluses of resistance to compression and of rigidity (resistance to change of shape) ; and, following Green, gave us the equations of equilibrium and motion of isotropic elastic solids, with their two distinct moduluses, which constitute the whole theory of equilibrium and motion of elastic solids as we have it at this day.

Seven years later, building on the foundation he had laid, he communicated another great paper to the Cambridge Philosophical Society,[1] "On the Effect of the Internal Friction of Fluids on the Motion of Pendulums." In this paper he solved the following very difficult problems, taxing severely the mathematical power of any-one trying to attack them.

(1) The oscillations of a rigid globe in a mass of viscous fluid contained in a spherical envelope having for its centre the mean position of the globe.

(2) The oscillations of an infinite circular cylinder in an unlimited mass of viscous fluid.

(3) Determination of the motion of a viscous fluid about a globe moving uniformly with small velocity through it.

(4) The effect of fluid friction in causing the rapid subsidence of ripples in a puddle and the slow subsidence from day to day of ocean waves when the storm which produced them is followed by a calm.

Of solution (3) he makes a most interesting application to explain the suspension of clouds by determining from the known viscosity of air, the terminal velocity of an exceedingly minute rigid globule of water falling through air. His formula for this has been used with excellent effect in the Cavendish Laboratory by Prof. J. J. Thomson and his research corps ; first, I believe, by Townsend in determining approximately the diameter of the globules in a mist produced by electrolysis, by observing its rate of subsidence when left to itself in a glass bell.

In the interval between the two great papers of 1843 and 1850, Stokes gave another magnificent hydrokinetic paper,[2] "Theory of Oscillatory Waves," containing a thoroughly original and masterly investigation of a most difficult problem, the determination of the motion of *steep* deep-sea waves. As an illustration of his results, he gives a diagram (M. and P.P., vol. ii., p. 212) showing the shape of a deep-sea wave in which the difference of level between crest and hollow is seven-fortieths of the

[1] "Collected Mathematical and Physical Papers," vol. i., pp. 329–357. From Cambridge Philosophical Society, March 11, 1850.

[1] December 9, 1850, M. and P. P., vol. ii., pp. 1–141.

[2] Camb. Phil. Soc., March, 1847, M. and P. P., vol. i., pp. 197–229, with supplement first published in the reprint M. and P. P., pp. 316–326.

wave-length—an admirable triumph of mathematical power.

He proved (vol. i. p. 227) that the steepest possible wave has a crest of 120°, with slope of 30° down from it before and behind. He *hoped* to work out fully its shape, and would no doubt have succeeded had time permitted.

Four short papers of July, 1845, February, 1846, May, 1846, and July, 1846,[1] show that in those early times Stokes had taken to heart the wave theory of light. His later splendid work on light has given such great results that even in the scientific world Stokes is often thought of only as a worker in optics and the wave theory of light. Truly his work in this province is more than enough for the whole life-time of a hard-working searcher in science.

A short paper of great value,[2] "On the Formation of the Central Spot of Newton's Rays beyond the Critical Angle," touches in its title a physical question of fundamental importance—*What motion takes place in the ether close behind the perfect mirror presented by total internal reflection?* And the answer to it given in the paper is admirably clear and satisfactory.

A little later, we find one of the most important of all of Stokes's papers on light,[3] "The Dynamical Theory of Diffraction." This paper contains the full mathematical theory of the propagation of motion in a homogeneous elastic medium. It contains, also, application of the theory to the disturbance produced in ether by a Fraunhofer grating for the two cases of incident light, (1) with its vibrations *in* the plane of incidence, and (2) with its vibrations *perpendicular to that plane* (therefore parallel to the lines of the grating). Lastly, it contains a description of an elaborate experimental investigation by himself, and a comparison of the results with theory, from which he concluded that the plane of polarisation is the plane perpendicular to the direction of vibrations in plane polarised light. This conclusion, notwithstanding adverse criticism by Holtzmann,[4] was confirmed by Lorenz, of Copenhagen.[5] The same conclusion was arrived at from the dynamics of the blue sky by Stokes and Rayleigh, and from the dynamics of reflection at the surface of a transparent substance by Lorenz and Rayleigh. We may now consider it one of the surest truths of physical science.

The greatest and most important of all the optical papers of Stokes was communicated to the Royal Society on May 27, 1852, under the title "On the Change of the Refrangibility of Light."[6] In this paper, his now well-known discovery of fluorescence is described; according to which a fluorescent substance emits in all directions from the course through it, of a beam of homogeneous light. The periods of analysed constituents of this fluorescent light, in all Stokes's experiments, were found to be longer than the period of the exciting incident light. But I believe fluorescent light of shorter periods than the exciting light has been discovered in later times.

Stokes found that the fluorescence vanished very quickly after cessation of the incident light. A beautiful supplement to his investigation was made by Edmond Becquerel showing a persistence of the fluorescent light for short times, to be measured in thousandths of a second, after the cessation of the exciting light.

Stokes's fundamental discovery of fluorescence is manifestly of the deepest significance in respect to the dynamics of waves, and of intermolecular vibrations of ether excited by waves, and causing fresh trains of waves to travel through the fluorescent substance. The prismatic analysis of the fluorescent light for any given period of incident light was investigated by Stokes for a large number of substances in his first great paper on the subject, and was followed up by further investigations by Stokes himself in later years, of which some of the results are given in his paper "On the Long Spectrum of the Electric Light" (*Phil. Trans.*, June 19, 1862).

Stokes's great paper on the refrangibility of light is the last paper of the last volume (vol. iii.) hitherto published of his mathematical and physical papers. It is to be hoped that with the least possible delay we shall have a complete collected republication of *all* his other papers. Every one of them, however small, will in all probability be found to be a valuable contribution to science; witness, for example, his paper of twenty-one lines in the *Phil. Mag.* for October, 1872. Let us hope that manuscript may be found for the communication to the Royal Society promised at the end of that paper.

Stokes's scientific work and scientific thought is but partially represented by his published writings. He gave generously and freely of his treasures to all who were fortunate enough to have opportunity of receiving from him. His teaching me the principles of solar and stellar chemistry when we were walking about among the colleges some time prior to 1852 (when I vacated my Peterhouse fellowship to be no more in Cambridge for many years) is but one example. Many authors of communications to the Royal Society during the thirty years of his secretaryship remember, I am sure gratefully, the helpful and inspiring influence of his conversations with them. I wish some of the students who have followed his Lucasian lectures could publish to the world his *Opticae Lectiones;* it would be a fitting sequel to the "Opticae Lectiones" of his predecessor in the Lucasian chair, Newton.

The world is poorer through his death, and we who knew him feel the sorrow of bereavement. KELVIN.

[1] M. and P. P., vol. i., pp. 141–157.
[2] Camb. Phil. Soc., December 11, 1848, M. and P. P., pp. 56–81.
[3] Camb. Phil. Soc., November 26, 1849, M. and P.P., pp. 243–328.
[4] *Poggendorff's Annalen*, vol. xcix., 1856, or *Phil. Mag.*, vol. xiii. p. 135.
[5] *Poggendorff's Annalen*, vol. iii., 1860, or *Phil. Mag.*, vol. xxi. p. 321.
[6] *Phil. Trans.* and M. and P.P., pp. 259–407.

RECENT METHOD IN PRACTICAL MATHEMATICS.

Höhere Analysis für Ingenieure. Von Dr. John Perry. Autorisierte deutsche Bearbeitung von Dr. Robert Fricke und Fritz Süchting. Pp. viii+423. (Leipzig und Berlin: Teubner, 1902).

CONSIDERING the poor opinion the Germans express for the school of mathematics in this country, it is a great honour for Prof. Perry that his "Calculus for Engineers" should be considered suitable for translation as conveying a message of new method worthy of imitation and adoption.

The improvement of the mathematical instruction

required for practical engineers and electricians has been exciting considerable attention in Germany, as shown by a series of addresses by Prof. Klein, Dr. Erwin Papperitz ("Die Mathematik an der deutschen technischen Hochschulen") and others on this subject, thereby attention has been directed to the stimulating method of Perry, who has utilised the idea due originally to Squeers and worked it to a practical result.

The book, as a series of events connected by a slight thread of continuous theory, suggests a mathematical Pickwick; the subject is inculcated by a succession of practical problems, chiefly of electrical and engineering interest, always completed very usefully by an arithmetical application to a real case. As in Pickwick, these applications have a personal flavour, which must not be lost by research delayed too late even where they are malicious, as in the story of the theorist who proposed an electrical condenser which would have cost a million, or perhaps even a billion, pounds to build.

The state of mathematics in England, as indeed of most learning, is in a very depressed condition. The school at Cambridge is going down hill; the numbers in the mathematical tripos are diminishing so rapidly that it has sunk from its former proud position to third on the list in size. The decay started when the examination was divided into two parts, and the first half was advanced into the summer time, on the simple innocent plea that it would force the men not to waste their time with gaieties. These gaieties flourish more unrestrictedly than ever, and so the examination is held earlier still so as not to clash with boat races and other frivolous fixtures, and the three years' course, as it is called, is reduced to about two years and a half, to suit the convenience of the college tutors, who are allowed to run the University in their own interest. As showing the danger of ill-considered reform, it is ruled now that a return is impossible to the old system, which worked quite well; and to remedy matters a new scheme was nearly adopted of reducing the time still further, ostensibly to two years, really to one-and-a-half. At this rate, the Cambridge student of mathematics will soon be as extinct as the Bachelor of Salamanca.

As for the second part of the mathematical tripos the standard has been raised not quite to infinity, as there are still a few stray candidates, but they barely outnumber the examiners. Contrast this with the good old days when Lord Kelvin was an examiner and there were fifty wranglers out of a total of one hundred candidates; the men had the advantage then of three years and a half, an extra eight months of the most valuable time, including a third long vacation and fourth October term, to revise their work and digest it thoroughly, not to mention the stimulus for the teaching staff of dealing with a greater variety of subjects than in the present elementary dull round.

Perry's book is probably considered very unsuitable for the Cambridge student, but it would serve as a corrective to the tendency to run after such a singular attraction as the Ostrogradsky Paradox, so recurrent as showing the lack of physical touch in the recent school of thought. The student of physical proclivities is driven away now into the natural or mechanical science tripos. In former days, there was a mathematical school of natural philosophy which produced Adams, Stokes, Thomson, Tait, Maxwell, Rayleigh and Hopkinson; this school, which the Germans envied, has been thrown into the melting pot, and an attempt is made instead to rival the Germans in their own particular line of pure abstract analysis, starting twenty or thirty years behindhand, and no wonder the Germans despise such servile imitation.

The last century closed with events which have called up heart-searching as to the cause of our state of decadence and decrepitude. Prominent among the causes was the low state revealed of our intellectual ideal in the public service. But what else can be expected from a system which allows our Civil Service Commission to lower this ideal to mere mark-hunting hunger and to play into the hands of the crammer, so that we go forth with jaded, undisciplined brain and intellectual dyspepsia to encounter a keen, intellectual foe? Our Government experts on education for the public service have shown they are ignorant of the psychology of their profession in producing such universal distaste for all the mental resources required to keep the mind in an active, healthy state. We must have a substitute as near to the high ideal of the American West Point Military Academy standard as we can attain if we are to recover lost ground.

With our present system, there is no incentive to effort once the obstacle of the Civil Service entrance examination is past by the aid of the crammer, and so the intellectual pace is set by the slowest. Double as many should be entered as are allowed to pass out, as at West Point, and the weeding-out process should go on continually, so as to excite competition to escape the last place, as great as among the Chinaman's ducks.

"What is to be said of an institution (Coopers Hill) where 20 per cent. of the candidates fail?" Lord George Hamilton asked, thinking perhaps of Sandhurst, where all pass out without exception; what would Lord George have to say about West Point, we wonder, where 50 per cent. do not graduate?

Hitherto, even in the Navy, there was room for improvement in intellectual alertness; the young aspirant was required to show more scripture knowledge than a bishop would exact from a candidate for ordination; but he knew no Greek, so his culture was of the middle class, Hebraistic rather than Hellenistic, as Matthew Arnold has said. He lost the inspiration of the history and strategy of the first great naval power in the Mediterranean to show him the identity of the tactics of the triremes and galleys and of the modern torpedo-flotilla; and it is perpetual stimulus of this kind that is required to keep him fresh and active in mind, like a Nelson, ready prepared by historical analogy for all possible events.

We lost the American colonies from defects in our naval strategy and the absence of loyal cooperation by sea and land; the same will happen again under our present system, where the admiral, with the fear of Byng's court-martial before him, plays his own game regardless of his partner; the force of Voltaire's proverb, *pour encourager les autres*, is not lost on the foreign strategist.

Prof. Perry, in his writings and addresses, has done much to introduce a higher ideal and to combat prejudiced

officialism; he is having a hard battle, but there are signs of victory in sight; the appearance of this translation will add to the discomfiture of his antagonists, when they see that he has secured an influential following in Germany.

The translation is very faithful—rather too much so in parts where misprints and slight errors have not been corrected, as, for instance, in § 189, where an attempt is made to show why alternators tend to synchronism when in parallel; Prof. Perry should develop the facts more thoroughly, as we know now that the tendency to synchronism exists only under very restricted conditions not always to be secured in practical working.

Dr. Robert Fricke's experience as a professor at a technical high school has had a useful effect of correction on the sublimity of his researches in the exalted regions of modular and automorphic functions, and has led him and his colleague to appreciate a work which most professional mathematicians are too prejudiced to understand. A. G. Greenhill.

A MUSEUM CATALOGUE.

Descriptive and Illustrated Catalogue of the Physiological Series of the Museum of the Royal College of Surgeons, London. Vol. ii. Pp. ix + 518. Second edition. (London: Taylor and Francis, 1902.)

It is now more than two years since we reviewed the first volume of this series (Nature, vol. lxii. p. 385), and to the present one, the second, we are disposed to extend even greater praise than to the first. The book has thrice the bulk of its predecessor, and it is wholly concerned with the descriptions of the nervous system of certain Invertebrates, and the brain and spinal cord, with their membranes and blood-vessels, of Vertebrates. Its main portion is the work of Prof. Elliot Smith, of Cairo, now our foremost authority on the Vertebrate brain; and in it he describes the brains of the Reptilia and Mammalia in a manner never before attained. He was induced to undertake the task by Prof. C. Stewart, the curator of the museum, at the time at which, in the ordinary course of work, the unparalleled series of mammalian brains which the College possesses were being remounted. Ripe for the opportunity of handling this material, Dr. Elliot Smith has given us, not a mere catalogue, but a masterly treatise teeming with revisionary and new observations, which make for orderly treatment and simplification in a manner surpassing those of most previous essays of the kind.

Some notion of his methods and results may be formed from a brief *résumé* of his work on the "pallium" and "Sylvian fissure," two of the most important things of which he treats. In dealing with the former, he applies to the pyriform lobe and the hippocampus the terms "basal" and "marginal" pallium, in order sufficiently to emphasise, for the first time, the fact that the intervening area or "neopallium," the most variable, is both morphologically and physiologically the most important pallial constituent, and that in the study of this, which he defines as "the organ of associative memory," lies the clue to the chief determination of the real nature of at least the cerebrum of the leading mammalian types.[1] As to the "Sylvian fissure," we meet with an ever-recurring treatment of it throughout the book; and in establishing the fact that the cortical areas from which its lips are formed are non-homologous in different mammals, the author shows that by failure to appreciate this in the past an inextricable confusion has arisen. Concluding that the Sylvian fissure proper is in its complete form found only in the human brain, and proving that it results from the meeting of three sulci phylogenetically distinct and variable in extent and interrelationship among the lower forms, introducing a rational terminology, he has systematised this complex subject on entirely new lines; and it is worthy of remark that he of necessity once more establishes a distinction between the pallial surface of man and the higher apes.

This much is simply revolutionary, but it is characteristic of the whole book; and when it is seen that the brains of representative members of every family have come under review, that in the case of many extinct forms casts of the brain-cavity have been studied, that there are 220 new illustrations, in themselves as accurate as the text, and that an all-sufficient bibliography is given, the result is one upon which all concerned are to be heartily congratulated.

The book forms the framework of an arch, of which the parts necessary for its completion have been obtained by the study, in Cairo and elsewhere, of such material as was originally lacking. There will shortly appear in the *Transactions* of the Linnean Society two memoirs directly related to this catalogue, which, as read, give promise of results at least equal to those of the author's great achievements with the Edentata, the Monotremes and Marsupialia, now everywhere recognised as of prime importance and in the highest degree luminous. Whenever possible, series of brains of each individual species have been studied, and memoirs and catalogue combined will furnish the finest contribution of the last quarter of a century to the science of cerebral topography and the analysis of the commissural systems of the brain.

The minor portion of the catalogue is contributed by Mr. R. H. Burne, the assistant to the curator, and is based on anatomical preparations fully equal to those through which he has obtained distinction in the building up of the collections. The Echinodermata, Annelida, Arthropoda and Mollusca, with the Protochordata, Cyclostomi, Pisces, Amphibia and Birds, have fallen to his lot; and he is responsible for the concluding sections on the membranes, blood-vessels, and spinal cord. Accuracy of detail is the distinctive feature of all that he has put on record, and he has introduced a novel method of display. He gives us new and welcome drawings of microscopic sections of the ganglia of not a few invertebrate forms and of the teleostean pallium, with a bibliography sufficient for the first needs of those who may desire further information. He has played a good second to his distinguished co-author, and a magnificent volume has been produced, worthy the best associations of the great institution whence it originates, the

[1] Pp. 465–466, in which the author elaborates this theme, are fascinating reading.

enthusiasm and foresight of its curator, and the cost of its production, which must have been heavy, and which its council have so liberally borne. Inseparable from the great collections it elucidates, this book should attract workers to them. It furnishes the basis from which all future research on the morphology of the mammalian cerebrum that shall be exact must take its start.

LIGHT FOR STUDENTS.

Light for Students. By Edwin Edser, A.R.C.Sc., &c. Pp. viii + 579. (London: Macmillan and Co., Ltd., 1902.) Price 6*s.*

THIS book is intended to meet the wants of the same class of students as the author's "Heat for Advanced Students," published three years ago. It gives a comprehensive account of the phenomena and laws of geometrical and physical optics, with a number of simple, illustrative experiments and examination questions. Special pains have been taken throughout, as in the author's "Heat," to make all the explanations as simple as possible, so that the private student, who has not the advantage of a teacher's assistance in explaining his difficulties, should find the book particularly helpful. Advanced mathematical methods have been scrupulously avoided, and the calculus is rigidly excluded. This necessarily limits the scope of the work, but the author has found it possible to give a very good general idea of the more difficult parts of the subject and of comparatively advanced theories, such as Sellmeier's theory of dispersion, without making any extravagant demands on the mathematical knowledge of the student.

The first ten chapters are devoted to geometrical optics, the last ten to the development of the wave theory of light. A brief summary is given of the properties of thick lenses, as introducing an account of the eye and of vision through lenses and spectacles. In the chapter on optical instruments, the construction of eye-pieces is dealt with at unusual length, but on the other hand, the account of telescopes is somewhat scanty. Little or nothing is said about the conditions affecting the brightness of the image or the extent of the field of view. The ray diagrams are drawn, following the prevailing custom, without indicating the correct position of the eye. The diagram of Galileo's telescope shows a pencil of rays full and central on the object-glass, and small and excentrical on the eye-lens. This is the common practice in text-books, but it does not correctly represent the conditions of vision through this instrument.

The following experiment is given as a proof that the spherical aberration of the eye is over-corrected:—

"Expt. 35.—Close one eye, and place the other at a distance of less than ten inches from a printed page, so that the type cannot be clearly seen. Then place a pinhole immediately in front of the pupil. The printing will become clearly visible, although rendered fainter owing to the loss of light."

Simple experiments of this kind are very helpful to the student, but in this particular instance the conclusion is hardly justifiable. The pinhole would also make the print clearer if held near the margin of the pupil or if the print were beyond the distance of distinct vision of a short-sighted eye. The experiment would be more appropriate as an illustration of increased depth of focus produced by stopping down a lens. An adequate test of the spherical aberration of the eye is not quite so simple.

The wave theory of light is introduced by a chapter on vibrations and waves in general, including an elementary account of the propagation of transverse waves in an elastic solid. This is followed by a general explanation of the rectilinear propagation of light, and of the reflection and refraction of waves. The chapter on the spectrum contains many illustrations from astronomy, such as the proof of the nature of Saturn's rings derived from the Doppler effect. But no account is given of theories of colour vision or of experimental methods of investigation. The chapters on interference, diffraction and polarisation contain photographic illustrations by Mr. W. B. Croft and others of fundamental phenomena. Some account is also given of recent instruments and experiments, such as the echelon grating and Rubens's experiments on infra-red rays of great wave-length. Limits of space have prevented the author from giving an account of the electromagnetic theory of light. The advisability of this would also have been questionable on other grounds. The book, considering its size, already contains an unusually large amount of information, and more could not reasonably be expected by the class of student for whom it is written.

H. L. C.

OUR BOOK SHELF.

Mr. Balfour's Apologetics Critically Examined. Pp. vi + 232. (London: Watts and Co., 1902.) Price 3*s.* 6*d.*

THIS book, issued anonymously by the Rationalist Press Association, is explicitly directed against Mr. Balfour's defence of Christianity (p. 10). To those who read with an animus against this "decaying creed," the author's vigour and lavish use of epithets may appear conclusive reasoning. To the impartial, it will scarcely appear to be criticism at all. Mr. Balfour's method in the "Foundations of Belief" was to advance from the more general philosophic position to the problem of "Provisional Unification." However much his critic believed that Mr. Balfour's theism was based on "emotion and sentiment" (p. 222), or that it could be explained by a review of his pedigree (p. 224), he had no right to rely too much on this application of the historical method.

At least, one expects to find that the "frontal attack" which the author prefers to Mr. Balfour's "sap and mine" (p. 222) shall be directed against the real stronghold. Yet, so far as this book goes, the author leaves untouched the questions, Has experience any elements which cannot be treated as we treat knowledge of "things"? If so, do these elements constitute data from which we may infer that "the whole circuit of belief" has wider foundations than "science" as such requires? And lastly, if the foundations are thus widened, do they admit Theism or Christianity as a form of it? It is easy to call the Incarnation a manifest absurdity; what is

wanted in a criticism of Mr. Balfour is some recognition of the philosophic position which led "a man of Mr. Balfour's intellectual power and high social standing" into a position which our author thinks "in many respects absurd and in all respects untenable" (p. 221). What is the author's philosophy? He thinks "all knowledge is science" and "science is all knowledge" can be interchanged; no explanation or defence is given; he considers sense-perception "the sole foundation of knowledge" (p. 149), and elsewhere asks whether Mr. Balfour has any channels of knowledge other than the senses and the intellect—an addition not without significance. Science (p. 26) is based on the evidence of the senses; theology is vitiated by having no such immediate contact with the evidence of the senses; yet "science is the only reasonable foundation on which Mr. Balfour's theology could be built" (p. 25).

The author considers Mr. Balfour has "uprooted the fabric of science" (p. 26). The careful reader will remember that the passage from which the author quotes the words "habitually mendacious" (p. 23) occurs in "Foundations of Belief," part ii., chap. 1, § iv., and that there Mr. Balfour does not argue that "we are unable to prove the reliability of the senses or the existence of an external world" (p. 147), but only that the "immediate experience" upon which so much has been said is really mediate, and that science now refutes the philosophy which shelters its bad psychology under so good a name. This may be enough to save the unphilosophic reader from thinking that the author writes from an assured position. His discussion of the cardinal questions of "cause," "uniformity" and the like is inadequate; he is equally unfortunate in labouring to disprove (p. 132) a theory which in Mr. Balfour appears as an example of individual bias and is put into the mouth of "the third of our supposed jurymen" ("Foundations of Belief," ed. 1895, p. 314); while the chapter on "Ethics," in itself good, is equally irrelevant; to say that by "religious truths Mr. Balfour means ethical truths" is a gratuitous assumption. The book has far too few references, always inverted and sometimes inaccurate. The index is designed to be amusing; occasionally it is useful.

G. S. B.

La Vie des Animaux illustrée. By E. Perrier. Pp. xxviii + 124. (Paris: Baillière et Fils, n.d.) Price Fr. 6.

IF we may judge by the first number, of which we have received a copy from the publishers, this new natural history bids fair to eclipse all publications of a similar nature by the number and beauty of its coloured plates. The name of the Director of the Paris Museum of Natural History is a sufficient guarantee that the text will be all that it should be; while the fact that the coloured plates are from sketches by Herr W. Kuhnert testifies that from both the artistic and the realistic points of view they will have few rivals. The authorship of the sections devoted to mammals and birds has been entrusted to Dr. H. Menegaux, who, in the part before us, treats in a popular, but at the same time exact, manner of the apes, monkeys and lemurs. No less than eighty coloured plates, as we learn from the title-page, are to be assigned to the illustration of the mammals, and of these, nine appear in the present part of 124 pages. All are first-class examples of three-colour printing, and we believe that such a wealth of illustration has never before appeared in a popular natural history. In addition to the coloured plates, the part before us contains a large number of text-figures, all reproduced from pen-and-ink sketches by Herr Kuhnert. As the publishers state in their prospectus, such illustrations are far superior, both from the artistic and the zoological aspects, to reproductions from photographs drawn from miscellaneous sources, which are generally out of harmony with one another and too often fail to display the characteristic features of the animals they represent. We notice that the author refuses to accept modern innovations in nomenclature, retaining, for instance, the familiar Mycetes (in place of Alouatta) for the howling monkeys. One of the main arguments used by the advocates of such changes was that it would conduce to uniformity; but experience seems to suggest that it will have exactly the contrary effect, and if so, where is the justification for such changes?

The work, so far as we can at present judge, is worthy of all commendation, and ought to obtain a large circulation on the other side of the Channel. The price is six francs per part.

R. L.

Das biomechanische (neo-vitalistische) Denken in der Medizin und in der Biologie. By Prof. Moriz Benedikt. (Jena: Gustav Fischer, 1903, published 1902.) Pp 57. Price 1.50 marks.

PROF. BENEDIKT protests against the distinction often drawn between mental and natural sciences. Mental science should have an experimental basis; natural science cannot complete itself apart from philosophical psychology. Physical and chemical formulæ do indeed apply to vital phenomena, but they are inadequate for a complete interpretation; "Biomechanik" requires to be supplemented by a "Seelen-mechanik." Every "manifestation" (M) or expression of vital activity (Lebensäusserung) is a function of the inherited "nature" or heritage (N); of the "second nature" or external "nurture" of appropriate environment, psychical as well as physical (N′); of less essential developmental or environmental influences (E); and of incidental or occasional interruptions (O). Thus we reach the vital equation

$$M = f(\pm N, \pm N', \pm E, \pm O).$$

This does not strike us as particularly novel, but Prof. Benedikt works it out in an interesting essay—an apologia for neo-vitalism—in which he discusses cell-life, action at a distance among cells, nervous activities, circulation-phenomena, growth and reproduction. The author hopes that "der feinfühlige Leser" will appreciate his effort at simplicity; but we must condemn ourselves in confessing that we have found his essay exceedingly difficult. It suggests a half-revealed secret, but what the secret is we have been unable to discover.

J. A. T.

Monographie des Mutillides d'Europe et d'Algérie. Par Ernest André, Membre de la Société entomologique de France. Pp. 478. Avec 15 planches coloriées et noire. Forme le Tome viii. du "Spécies des Hymenoptères." (Paris: Hermann, 1903.)

IT is only a short time since we had the pleasure of noticing the first half of vol. vii. of this important work, which contained the commencement of the Cynipidæ, and already vol. viii. lies before us, containing the Mutillidæ, edited by Ernest André, the brother of Edmond André, the founder of the work, to whose memory this volume is dedicated.

The Mutillidæ are an interesting family of insects, which were thus named by Linnæus because the females of the commonest species are apterous. They were formerly called solitary ants and were placed near the Formicidæ, but are now more properly regarded as forming a family of the Fossores, or burrowing wasps. There are only three species in Britain, which are not very common; but in warmer countries, and even in the Mediterranean region, they are much more numerous. About 120 species are discussed in the work before us, besides very numerous varieties. The total number of described species is estimated at 1600. The family is divided into four tribes, or subfamilies, Fedschenkiinæ, Apterogyninæ, Methocinæ and Mutillinæ but only

seventeen species are referred to the first three sub-families altogether, the whole of the remainder falling under the fourth, and typical, subfamily.

The sexes are very different, and it is not always easy to identify them, the males being winged, and often much smaller and slenderer than the females. The head, thorax and abdomen are usually sharply separated, and the body is clothed with very thick down, and is more or less brightly coloured, for even where the prevailing colour of the abdomen is black, it is usually marked with bands or large spots of red, yellow or silvery white.

So far as their habits have yet been observed, the Mutillidæ are parasitic in the nests of various ground-bees and burrowing wasps.

We have so recently reviewed one of the volumes of this series that it is, perhaps, unnecessary to say more than that the arrangement of this volume is similar to that of its predecessors and that it appears to be fully equal to them in execution, both as regards the text and plates. W. F. K.

Publications of West Hendon House Observatory, Sunderland. No. 2. By T. W. Backhouse, F.R.A.S. Pp. viii + 161. (Sunderland: Hills and Co., 1902.)

THIS volume contains the detailed observations which have been made by Mr. Backhouse on the structure of the sidereal universe, comets Barnard (1886) and Holmes (1892), the Zodiacal Light, the Aurora Borealis, and variable and suspected variable stars.

The first part of the observations of the sidereal universe was contained in a previous similar publication (No. 1), and in this second part the author deals with the observations of radiating systems, lines and parallelisms amongst the stars, and the Milky Way.

The author has arranged his table of observations of "Auroræ" (which extend from January, 1860, to Midsummer, 1896) so as to indicate whether or not there is any foundation for supposing the appearances of this phenomenon to have a periodic fluctuation. The table, together with the accompanying curve, indicates a period of sixty-five days, which includes a well-marked succession of maxima at intervals of twenty-eight days.

The last section of the book, dealing with the observations of variable and suspected variable stars, includes an introduction on the "Calculation of Star Magnitudes," observations of the "Orange Stars near η Geminorum" and the "Brighter Stars in Hercules and Neighbourhood," together with a descriptive diagram of the variation of V Aquilæ.

Buttermaking on the Farm and at the Creamery. By C. W. W. Tisdale and T. R. Robinson. (London: John North, the *Dairy World* Office, 1903.) Price 1s.

THIS little book is, strictly speaking, a handbook on practical buttermaking. It has the merit of being thoroughly up-to-date, in that the whole process of buttermaking is dealt with in minute detail, and the practice recommended is based on the latest scientific research connected with dairying. It does not describe dairy implements or breeds of cattle, but simply the making of butter and the management of the milk and cream from which it is produced, and it is probably the best of the handbooks on practical buttermaking. The treatment of milk and cream at the factory is fully dealt with, as well as at the farm, and also such subjects as pasteurisation, ripening of cream on a large scale, purchase of milk according to quality, and the packing and marketing of butter. There are also one or two excellent illustrations, showing the appearance of butter in different stages of churning and making. DOUGLAS A. GILCHRIST.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Sir Edward Fry on Natural Selection.

I HAVE only just read the memoir of Sir Edward Fry in the January number of the *Monthly Review* on "The Age of the Inhabited World." With its general purport I am in sympathy, and I rejoice in the opportunity of offering a tribute of praise to the extreme lucidity of the language in which it is expressed; but for those very reasons I desire to protest against one of his arguments, which seems to me so faulty as to seriously compromise the value of the memoir as a whole. He is endeavouring to show that natural selection is incapable of doing much that has been accredited to its agency, and uses, p. 78, these words in respect to mimetic insects:—

". . . . the useful deception will not take place until the protected form is nearly approached. Thus during the whole interval occupied in passing from the normal form of group A to near the normal form of group B, natural selection will have been entirely inoperative. . . . Either birds are deceived by a small amount of imitation or they are not. If they are, natural selection cannot have produced perfect imitation; if they are not so deceived, then group A has passed over from its original form to something close upon the form of group B without any guidance from this principle."

I deny this sharp dilemma and assert the existence of many intermediate stages. Two objects that are somewhat alike will be occasionally mistaken for one another when the conditions under which they are viewed are unfavourable to distinction. The light may be faint, only a glimpse of them may have been obtained, the surroundings may confuse their outlines. While these conditions remain unchanged, the frequency of mistake serves as a delicate measure of even the faintest similarity. Prof. McKeen Cattell measured in this way the relative resemblances (in other words the want of distinction) between various printed letters of the alphabet. He placed them on a screen behind a drop slide that had a horizontal slit, giving a uniformly brief glimpse of the letters while the slide was falling. He found, as might have been expected, that "i" was often mistaken for "l," "k" for "h," and so on, each couplet with its own special degree of frequency, which gave a numerical measure of the relative resemblances of the letters. Many other letters that seem ordinarily very unlike were occasionally mistaken for one another, each in a definite percentage of cases. So it must be with insects. If one of the edible group A has individual peculiarities within the limits of variation, that give it a resemblance, however slight, to one of the noxious group B, it will occasionally be mistaken by a bird for a B and allowed to live unharmed. The similarity may be due to a characteristic attitude, to a blotch of colour, to a preference for resting on a part of the foliage to which its own form bears some likeness, or to other causes. In any case, it may well prove to be the salvation of 1, 2 or more per cent. of those that would otherwise have been seen and eaten. If so, the thin edge of natural selection will have found an entrance, and its well understood effects must follow. FRANCIS GALTON.

Hotel Europe, Rome.

The Principle of Least Action.

MR. HEAVISIDE has done good service in calling attention to the *misuse* of this principle; and certain theories of electromagnetism, which have been recently proposed, afford a striking illustration of the value of his remarks and the limits within which the legitimate application of the principle is confined.

In many branches of physics, the equations of motion and the boundary conditions of the dynamical system under consideration cannot be obtained without making some hypothesis, which may or may not be true. One method of testing the truth of the hypothesis is by appeal to experiment, but the legitimate use of the P. of L. A. frequently supplies another. For the original hypothesis, when expressed in terms of mathematical symbols, leads to an energy function, from which the equations of motion and

the boundary conditions can be obtained by the aid of the P. of L. A.; and if the application of this principle leads to results which are dynamically unsound or impossible, the original hypothesis is vitiated even though the formulæ to which it leads should be found to agree with experiment. To endeavour to explain some new phenomenon by introducing a hypothetical term into the energy function, and to deduce the equations of motion and the boundary conditions by means of the P. of L. A., is perfectly legitimate as a tentative process; but the results thereby obtained require careful examination in order to ascertain whether or not they violate any of the fundamental principles of dynamics.

In some theories on the action of magnetism on light, the hypothetical term introduced into the energy function gives rise to certain additional terms in the equations, by means of which the motion and forces are specified, which make some of the forces discontinuous at the surface of separation of two different media. Theories of this kind consequently violate Newton's third law of motion, and can at best be only regarded as stop-gaps until some better theory has been discovered. On the other hand, the introduction of hypothetical terms into the equations which determine the forces, or some of them, *may* lead to an energy function which fails to reproduce the original expressions for the forces when the P. of L. A. is applied; and in cases of this kind the principle affords a valuable test of the correctness of the previous work. The principle, like a great many other mathematical theorems, has its uses, but to convert it into a "graven image" is to court disaster. A. B. BASSET.

Fledborough Hall, Holyport, Berks, January 30.

The Horny Membrane of Neohelia porcellana.

Two years ago, Miss Edith Pratt published in vol. v. of Willey's "Zoological Results" a paper on the anatomy of *Neohelia porcellana*. In this paper attention was directed to a horny membrane lining the hollow tube which forms the axis of the colony, and the suggestion was made that this horny membrane is secreted by the Neohelia itself. The single specimen which Miss Pratt had to investigate was, unfortunately, a small one, and in the criticisms which appeared some doubts were expressed as to whether this horny membrane was not secreted by some tubicolous worm which formerly inhabited the hollow tube of the corallum, and not by the Neohelia itself. I have recently had the opportunity of examining specimens of two species of the closely related genus Amphihelia, one (*A. oculata*) from a depth of 240 fathoms off the coast of Florida, the other (*A. ramea*) obtained by H.M.S. *Porcupine* in the Faeroe Channel, 363 fathoms. In both of them there is a horny membrane similar in character and position to that described for Neohelia. Now it is difficult to believe that a worm forming the same kind of tube, with the same habit of mysteriously disappearing when the corals are preserved, occurs in such widely separated districts as Florida, deep water, New Britain, shallow water, and the Faeroe Channel, deep water. The only reasonable conclusion is that these madrepores do actually secrete this horny membrane themselves. SYDNEY J. HICKSON.

Owens College, Manchester, February 2.

Genius and the Struggle for Existence.

MR. BULMAN, in NATURE of January 22, urges that what is good for the individual or race will survive unaided. But surely this is contrary to well-known facts. Man, with the increase of specialisation, which (whether it be an unmixed good or no) we find associated with his advance to a greater mastery over the rest of Nature, has become, so to speak, a polymorphic species, like the ants, bees or termites; and while in all species we find more or less mutual aid, in polymorphic species it is especially obvious that it is not the isolated individual types, but the total combination that natural selection regards, since the isolated types may be quite incapable of reproducing their kind and performing their special duties unaided.

In all such cases, the "survival" of the individual types, and of the community as a whole, depends, not on the competence of individuals to survive unaided, but on the recognition, instinctive or conscious, of each other's value, and the resulting mutual aid, given either under instinct or in conscious exchange. Now, as I understand, Sir O. Lodge has simply pleaded that steps be taken which, while (*pace* Mr. Bulman) not interfering one whit with the education of the 9999, shall lead to the recognition of the one exceptional genius, with a view to mutual aid, *i.e.* so that he may be set free to do the work of pioneer and leader, which he alone can do; and early, because *ars longa, vita brevis*.

We know that genius can be reared in night-schools, and about Palissy the potter; but ought we to count on our potter burning his furniture for our good, if we, with plenty of ordinary fuel, deny it him?

In the essay to which he refers in his letter in NATURE of January 29, Dr. Wallace attaches less importance to the rearing of a few men of exceptional qualities than to the weeding out of the worst and raising the average; but surely, without giving undue and exclusive credit for advance to the pioneers and prophets, we may take it that men like Darwin and Wallace himself, to mention only one type, will, under natural selection, render the later more conscious steps of man's evolution easier.

Dr. Wallace, in the letter referred to, speaks of the "fittest" not surviving under existing civilisation, meaning that many of the specialised types, which form important elements in our polymorphic communities, are not fittest to survive, and continue to reproduce their kind in more primitive or more ideal communities. But this, of course, accords well with the principle of the "survival" of those types "fittest" to the actual environment. (Survival, of course, does not postulate direct reproduction any more than it postulates long life; the "worker" bees "survive.") Further, Dr. Wallace's hopeful attitude shows that he really trusts "natural selection" to steer the best races of man to a point whence their further, more self-conscious, progress (still, as always, under natural selection) will be more and more in accord with Nature's will, and so less wasteful and pain-fraught.

Man is a self-conscious part of Nature, with the power to "look before and after"; and doubtless the races of man, which will rise highest under natural selection, will not let their faculty of taking counsel from natural and human history rest idle; but, just as Dr. Wallace himself showed years ago that "sexual selection," in the sense of choice of mates, had no power at all *against* "natural selection" (such selection being, I would say, of a faculty or instinct developed by natural selection, and from time to time modified by natural selection to suit changes in the environment), so this conscious "human selection" is but a faculty of man that is being developed (indirectly, perhaps) by natural selection, and can have no power at all to thwart "natural selection," though its wise use may save our race much of the pain that results from fruitlessly "kicking against the pricks." G. W. BUTLER.

February 3.

IT is, of course, true that genius has no survival-value in the struggle for existence between individuals or against physical conditions. But the case is very different when we come to the struggle between groups—tribes, village communities or nations. A tribe which produces a fine bard has far more fighting power than a tribe which has no singer. The possession of a noble literature makes England far more formidable than she otherwise would be. And from the days of flint instruments until now, the inventor has been the salvation of his people.

F. W. HEADLEY.

Remarkable Meteorological Phenomena in Australia.

ON Wednesday, November 13, 1902, we experienced here in Australia some most extraordinary meteorological phenomena. For the previous five or six days, exceedingly hot, dry weather had prevailed, owing to winds blowing from the Australian interior, where a huge anticyclone was resting, in a coastward

direction, the winds taking in Queensland and New South Wales a westerly, and in Victoria a northerly, direction. The hot weather culminated in terrific dust-storms in Queensland, New South Wales, Victoria and South Australia, and during these storms "fireballs" were seen hovering in the air. On the sea, "red rain" was experienced by several passing vessels.

The following is an abstract of what happened:—

Melbourne, Wednesday, November 13. Weather phenomenal, great heat, dust-storms, in all parts of Victoria.

At Boort, great fireballs fell in the street, throwing up sparks as they exploded. The whole air appeared to be on fire; intervals of complete darkness; lanterns had to be used in daytime, and fowls went to roost.

At Longdale, a house set on fire by a fireball.

Balls of fire burst on the poppet heads of the New Barambogie mine, Chiltern, Victoria, putting the timbering of the shaft on fire. Almost every meteorological station in Victoria sent in similar reports—fireballs, darkness in daytime, and people stumbling about with lanterns.

Sydney. On November 14, Mr. Bruggman, of Parramatta, was paralysed by a fireball bursting over his head.

Harden, Wednesday, November 13. During a storm yesterday at Murrumburrah, a huge "fireball" hovered over the houses for a considerable time and then disappeared.

H. I. JENSEN.

Caboolture, Queensland, January 1.

A New South Wales Meteorite.

ON reading the account of the fall of the Crumlin meteorite given by several correspondents in your issue of October 9, 1902, I was struck with the parallelism between this occurrence and the fall of the Mount Browne stone in this State on July 17 of this year. Mount Browne is situated near the township of Milparinka, in the extreme north-west corner of New South Wales. About 9.30 a.m. on that date, a loud explosion was heard. In the direction of the sound, a hut is said to have caught fire, this being immediately followed by a whizzing sound and the raising of a cloud of dust at some distance. The stone was picked up within five minutes, while still warm. It may now be seen at the Mining and Geological Museum, Sydney. Its present weight is about 25 lb., but a small piece has been broken off one end. The fractured surface is exceptionally light in colour, the stone being largely non-metallic.

An account of the phenomena attending the fall has been given by Mr. H. C. Russell in a paper recently read before the Royal Society of New South Wales. GEORGE W. CARD.

Sydney, December 23, 1902.

The Holy Shroud of Turin.

I AM sorry to find, from an interesting paper by the Rev. Father Thurston on the Holy Shroud in the current number of *The Month*, that I have mistranslated the passage from Chifflet's "De Linteis Sepulchralibus, &c." p. 198, in which he refers to the spirituous tincture of cinnamon and cloves being used for giving the correct colour in making a copy on linen of the Besançon shroud for King Philip II. of Spain, and not for depicting the King himself. Not having Chifflet's book at hand when writing, I overlooked the reference to the Besançon shroud, but the mistake does not affect the argument regarding the use of such tinctures by painters in the Middle Ages.

J. WATERHOUSE.

A Simple Sensitive Flame.

A USEFUL sensitive flame may be obtained from a Bunsen burner with the usual gas supply by completely excluding the air and lowering the gas pressure until the flame becomes lop-sided but quiet. Its range of sensibility extends for singing over the three octaves of the bass and treble clefs, for whistling over the middle octave of these three. The recovery is prompt enough to allow of a response to each note of a slow staccato passage. The type of burner found best is one with a brass tube three-eighths of an inch bore, with one side hole for air which is quite closed by a half-turn of its tightly-fitting sleeve. E. H. BARTON.

University College, Nottingham, January.

THE FUNERAL OF SIR GEORGE STOKES.

THE funeral of Sir George Stokes at Cambridge on Thursday last was an impressive ceremony in which distinguished representatives of many branches of learning took part. The University church was crowded in every part, and the assembly constituted a living witness to the esteem in which the memory of Sir George Stokes is held in the intellectual world.

The coffin containing the late Master's body was first carried round the court of Pembroke College, in accordance with an ancient custom reserved for Masters, the procession being formed of the choir and officiating clergy, the fellows of the College, former fellows, masters of arts, bachelors of arts and undergraduates.

At the gate of the College, the relatives in carriages took their place in the procession immediately after the fellows. All the other members of the College followed the carriages in their order to Great St. Mary's Church.

In the meantime, another procession was being arranged in the Senate House, comprising the Vice-Chancellor, the heads of houses, doctors, University officers, professors, and members of the council of the Senate, together with the representatives of learned societies. This procession included:—

The Vice Chancellor (Dr. F. H. Chase), with the registrary (Mr. J. W. Clark), in front of whom walked the Esquire Bedells; Lord Braybrook, Lord Kelvin, Sir Richard Jebb, M.P., the Masters of Trinity, Clare, Peterhouse, Trinity Hall, St. Catherine's, Jesus, Christ's, St. John's, Emmanuel, Downing, Magdalen, and Selwyn, Profs. Allbutt, Mason, Swete, Clark, Macalister, Bevan, Ward, Hughes, Lewis, Liveing, Ridgeway, Barnes, Marshall, Newton, Westlake, Mayor, Ewing, Skeat, Stanton, Ward and Reid: the Public Orator (Dr. Sandys), Dr. Routh, Dr. Guillemard, Dr. Harmer, Dr. W. G. Lax, Dr. D. Macalister, Dr. Haddon, Dr. James, Dr. Dalton, Dr. Jackson, Dr. Baker, Dr. Langley, Dr. McTaggart, Rev. Dr. Cunningham, Archdeacon Emery, the Rev. J. O. F. Murray, Rev. H. J. Sharpe, Messrs. Berry, H. Darwin Headley, Wright, Mollison, Scott, Shipley, Grey, Durnford, Wyatt, Magmisson, and many others.

The representatives of learned societies and other bodies were as follow:—

The Royal Society—Lord Kelvin (past president), Mr. A. B. Kempe (vice-president and treasurer), Dr. W. T. Blanford (vice-president), Prof. J. W. Judd (vice-president), Prof. G. Carey Foster (vice-president), Prof. R. B. Clifton, Sir Michael Foster (secretary), Dr. J. Larmor (secretary), Dr. T. E. Thorpe (foreign secretary), Sir Arthur Rücker and Prof. A. Schuster (fellows), Mr. R. W. F. Harrison (assistant secretary), together with Profs. Liveing, J. J. Thomson, G. H. Darwin, J. Dewar, A. R. Forsyth, Sir Robert Ball and Dr. Glazebrook. The president of the Royal Society was absent by medical advice.

Victoria University—Prof. Horace Lamb.

Owens College—Prof. Osborne Reynolds and Prof. A. Schuster.

Manchester Literary and Philosophical Society—Prof. Osborne Reynolds.

London Mathematical Society—Prof. Horace Lamb (president), Prof. A. E. H. Love and Prof. W. Burnside (secretaries), Dr. J. Larmor (treasurer).

University of Oxford—Profs. Turner and Clifton.

University of London—Sir A. Rücker (principal), Prof. Tilden (Dean), Sir William Ramsay.

British Association and Royal Institution—Prof. Dewar.

National Physical Laboratory—Dr. R. T. Glazebrook.

Solar Physics Committee and Observatory—Sir Norman Lockyer, Prof. George Darwin.

Institution of Electrical Engineers—Prof. W. G. Adams.

Victoria Institute—Prof. Hull and Mr. Martin Rouse.

Cambridge Antiquarian Society—Mr. T. D. Atkinson.

Chemical Society—Prof W. A. Tilden (treasurer).

Cambridge Philosophical Society—Dr. H. F. Baker (president), Prof. A. Macalister (past president), Mr. H. F. Newall (treasurer), Mr. A. E. Shipley, Mr. S. Skinner and Mr. H. M. Macdonald (secretaries), Prof. Liveing, Prof. J. J. Thomson and Dr. Hobson (members of the council).

Royal Astronomical Society—Dr. J. W. L. Glaisher (president).

Royal College of Science—Prof. W. A. Tilden.
Meteorological Council—Admiral Sir W. Wharton.
Christian Evidence Society—The Rev. C. Lloyd Engstrome.
Corporation of Cambridge—The Mayor (Councillor P. H. Young), the Ex-Mayor (Ald. G. Kett).

After the service, the procession left the church in the following order:—The officiating clergy, the body, the fellows of the college, the relatives, honorary fellows and former fellows of the College, the Vice-Chancellor and other representatives of the University, together with representatives of learned societies, members of the Senate, bachelors of arts, scholars, other members of the College, and all those desiring to attend the service at the Mill Road Cemetery, where the interment took place.

EXPLORATIONS IN ICELAND.[1]

DURING the nineteenth century, and up to the present time, a considerable number of books and magazine articles were published in England and America giving an account of travels in Iceland. The greater part of these writings contain merely personal details, interesting only to the narrator himself and his nearest relations; some remind us pleasantly of Mark Twain's "Innocents Abroad"; others are well written and possess some literary value, though these also are very liable to contain errors.

Some of these travels have a quasi-scientific tendency, but do not contain anything new, and very few contain anything of real scientific importance. We may, perhaps, say that the oldest books describing travels in Iceland are also the best, and that the books of Hooker (1809), Mackenzie (1810) and Henderson (1814-15) are far superior to nearly all later works. At that period, the traveller had time to study the literature and the people, and to investigate for himself the language of the country and the history and customs of the inhabitants. At the present day, people travel much more, and generally study very little; the traveller passes over half the world without any serious preparation beforehand, and, when he returns home, he considers it to be his duty to enlighten the reading public with a thick book containing observations and discoveries about matters which hundreds of other travellers have described much better before him. Fortunately, however, there are some honourable exceptions, and we are always delighted to welcome a book that really contains anything new. Mr. W. Bisiker's book belongs to this class. The author made it his object to explore and map out the district of Kjalvegur in Central Iceland, one of the most beautiful parts of the interior, which had never been surveyed in detail, and Mr. Bisiker's admirable map of the district is, therefore, of permanent geographical importance. The book also contains numerous photographs, which give a very good idea of the various geological and physico-geographical characteristics, and there are some good illustrations of the mode of travelling in Iceland. In addition, Mr. Hill has given some interesting notices of the distribution of plants in Kjalvegur, with a list of the plants which were found, among which is *Ophioglossum vulgatum*, which had not previously been found in Iceland.

Th. Thoroddsen.

Fig. 1.—The Funnel or Crater of Geysir. (From Bisiker's "Across Iceland.")

Fig. 2.—Immense Erratics. (From Bisiker's "Across Iceland.")

[1] "Across Iceland." By W. Bisiker, F.R.G.S. With an Appendix by A. W. Hill, M.A., on the Plants Collected. Pp. xii + 236. (London: Edward Arnold, 1902.) Price 12s. 6d.

ROYAL COMMISSION ON LONDON LOCOMOTION.

IT was announced on Saturday last that the King had been pleased to appoint a Royal Commission to inquire into the means of locomotion and transport in London. The Commission is also asked to report upon the following points:—

(*a*) As to the measures which they deem most effectual for the improvement of the same by the development and interconnection of railways and tramways on or below the surface, by increasing the facilities for other forms of mechanical locomotion, by better provision for the organisation and regulation of vehicular and pedestrian traffic, or otherwise;

(*b*) As to the desirability of establishing some authority or tribunal to which all schemes of railway or tramway construction of a local character should be referred, and the powers which it would be advisable to confer upon such a body.

The following are the Royal Commissioners :—

Sir David Miller Barbour, K.C.S.I., K.C.M.G., chairman ; the Earl Cawdor, the Viscount Cobham, the Lord Ribblesdale, the Right Hon. Sir J. C. Dimsdale, Bart., K.C.V.O., Sir J. P. Dickson-Poynder, Bart., Sir R. T. Reid, G.C.M.G., K.C., Sir Francis J. S. Hopwood, K C.B., Permanent Secretary to the Board of Trade, Sir J. Wolfe Barry, K.C.B., F.R.S., Sir G. C. Trout Bartley, K.C.B., Mr. Charles S. Murdoch, C.B., Mr. Felix Schuster and Mr. George Gibb; Mr. Lynden Livingston Macassey will act as secretary.

It will be seen that the reference to the Commission is very wide, and the Commissioners will have before them a task of no small difficulty and complexity. There can be little question but that the time was ripe for the appointment of a Commission, and it is to be hoped that the intricacy of the problem will not unduly delay the presentation of the final report, which, judging from the names of the Commissioners, may be confidently relied upon to furnish valuable suggestions for evolving order out of the present chaos.

London is said to have lagged far behind the large towns in other countries in its development of facilities for transport and locomotion. Whether this is due to our natural inertia in the application of the latest engineering developments or to the much greater difficulty of the problem in London, it is a fault which results in some advantages. Now that we are awake to the necessity of speedy and thorough reform, we are able to look round at what has been done elsewhere and select the methods which seem most suited to our special requirements. In this respect, the Royal Commissioners will have an abundance of material from which to choose. On the one hand they will have to consider the various methods of constructing tramways and railways, and on the other the means for relieving the congestion of the ordinary horse and motor traffic. Although it is probably recognised by all that electric traction has proved itself to be far the most suitable for urban and suburban tramways and railways, people are by no means in such close agreement as to the best methods of construction. The success and popularity of the Central London Railway have led many to suppose that the solution of London's traffic problem lies in the indefinite multiplication of "tubes." The experiences of the past Parliamentary session have, however, clearly shown that we cannot look forward to any such simple solution to be provided by private enterprise alone, and the fiasco which then occurred has emphasised the desirability of holding an authoritative inquiry to suggest some definite line of development even if only in reference to this point. The deep-level railway, however, possesses many obvious drawbacks, such, for example, as its lack of ventilation and its unsuitability for coping with short-distance traffic. Some of these might be avoided by the adoption of the shallow-subway railway or tramway, so strongly advocated by the London County Council, and this, at any rate in some localities, would go far towards satisfying the needs of the public. In addition to these, there is the overhead railway to be considered, and also the possibility of developing and extending the use of surface tramways.

The Royal Commission will have to consider, not only the relative merits of these different types of railways, but also the very important question of intercommunication. It is in this respect that progress by undirected private enterprise is least satisfactory, for it may be said that the most essential point is the provision of a number of independent units, each satisfying the wants of the district it particularly supplies, but yet forming a part of a definite and connected whole. Such vexed questions as what type of junction is best, which is the best method of charging, and many others of minor importance, all have to be considered in relation to this point. The appointment of a central authority with power to deal with questions such as these as they arise in the future, as is suggested in the second paragraph of the reference, cannot fail to have a beneficial influence on the orderly and systematic development of traction facilities in London. The problem is, of course, considerably complicated by the existence of several railways already, with which any new scheme will have to fit in ; but if this makes it impossible to carry out an ideal arrangement, as could be done if we were starting with a clean slate, it need not prevent the Commissioners from framing a satisfactory scheme.

The Commissioners are asked to report on the means of locomotion generally, and the railway and tramway question is only a small part of the traffic problem. Even with the diversion of as much traffic as possible to suitable railways, the London streets would still be congested. Let us hope that some means will be found for so regulating the horse traffic that it will become possible to make the most of the great advantages which are afforded by mechanical traction—whether by the private or public motor-car—and by the bicycle. The bicycle has already become, and motor-cars are rapidly becoming, a necessity, but the state of the London streets at present does not allow the capabilities of either to be used to the best advantage, and to this may be largely ascribed a part of our backwardness in the development of the engineering and technical side of the subject. Whether or not it may be found feasible to reserve certain roads or parts of roads for motor traffic, as suggested by the Prime Minister a short time ago, must remain at present an open question. Provision of some sort will have to be made, either in this way or by altering the methods of regulating traffic, to enable the mechanically propelled vehicle to properly perform its share in expediting London transport.

The whole question of London traffic is bound up with many side issues of the utmost importance to the community. Of these may be mentioned the housing question, the solution of which is certainly only to be obtained concurrently with the solution of the transport question. The breaking up of the streets for gas, water, electric light, telegraph, telephone and the many other public services also bears very directly on the locomotion question ; it is, indeed, one of the County Council's chief recommendations for their shallow-subway tramways that they will afford also a means of getting over this difficulty. The decentralisation of factories and workshops also depends largely on facilities of transport and locomotion. These and many other kindred problems will doubtless receive the consideration of the Commissioners. Lastly, the very important questions of cost and finance will have to be dealt with, since these form the touchstone by which the merits of any scheme will have to be finally tested.

Although we have only been able to touch on a few of the subjects with which the Commissioners will have to deal, enough has been said to show that they have before them no light task, and no one will feel surprised if it occupies them for a long period. The extreme urgency of the question makes it desirable that their report shall be forthcoming with the least possible delay, and still more that, when it has been presented, it should be immediately given practical application by the necessary legislation. There is no fear that on the scientific side of the subject any difficulties need be anticipated. It may be safely said that our engineers are capable of coping with the practical difficulties of any scheme that may be recommended. The difficulty lies, not in providing convenient means of transit—these, and many of them, are ready to hand—but in providing the facilities for their utilisation. Short of establishing a service of aërial cars, there is probably nothing in the way of "means of locomotion and transport" which modern engineering cannot provide, and this being the case, it is to be hoped that we may look forward to London being in a few years the first, instead of the last, of the large cities in its transit facilities.

MAURICE SOLOMON.

RECENT EARTHQUAKES.

IN connection with the announcement made in our notes columns (p. 349) of a remarkable disturbance in the Pacific on January 13 and of an earthquake in Jamaica on February 5, the following abstract of recent earthquakes recorded at Shide, Isle of Wight, which Prof. Milne has made at our request, is of interest:—

The most remarkable disturbance recorded at the Isle of Wight station during the month of January was one which commenced at 1h. 59m. a.m. on January 14. Maxima occurred at 2h. 36m. and 2h. 39m. At 3h. 34m. these are apparently repeated, indicating an origin 137° distant, and therefore possibly to the east of Tahiti—the scene of the recent disasters occasioned by hurricanes and sea-waves. Similar records were obtained at Kew, Bidston, Edinburgh, and probably at all stations furnished with instruments capable of recording the unfelt movements of large earthquakes.

Since the commencement of February, the earthquakes noted at Shide in the Isle of Wight have been as follows:—

Date.	Commencement. h. m.	Maximum. h. m.	Duration. h. m.	Amplitude. mm.
Feb. 1	10 1·6	10 18·9	1 5	6
,, 4	6 51·8	6 54·9	— 10	0·75
,, 5	19 4·5	19 46·2	2 30	2 to 0·75
,, 6	8 5·5	8 14·7	— 30	1·0

The first is a large disturbance which had its origin at some place about 4500 kms. distant, possibly in Turkestan. The third disturbance—which as recorded at Shide is small—may refer to the West Indies.

J. MILNE.

JAMES GLAISHER, F.R.S.

WE regret to see the announcement that Mr. James Glaisher died on Saturday last, February 7. Born April 7, 1809, he had nearly attained the great age of ninety-four years, the major portion of which was devoted to unceasing work of a varied nature, mainly, however, directed to practical meteorology.

At the age of twenty he was appointed as assistant on the principal triangulation of the Ordnance Survey of Ireland, and from 1833-1836 was an assistant at Cambridge University, whence he proceeded in the latter year to the Royal Observatory, Greenwich, and having been, in 1840, promoted to the position of superintendent of the magnetical and meteorological department, he remained there until his retirement from official life in 1874.

His contributions on subjects bearing on meteorology and astronomy were too numerous to allow of our giving more than a passing notice. His hygrometrical tables, published in 1847, which have reached their eighth edition, are still the standard work on the subject for the British Islands, and "Travels in the Air" (1871 and 1880), "Diurnal Range Tables" (1867), "Mean Temperature of Every Day for Greenwich, 1814-1873," "Report on the Meteorology of India" and "Meteorology of Palestine" are among his chief writings.

From 1862-1866 he made twenty-nine balloon ascents in the interests of meteorological science, and the results were given in reports to the British Association at their annual meetings of those years. The ascent on September 5, 1862, is particularly memorable from the fact that he and the late Mr. Coxwell attained the highest distance from the earth (37,000 feet) ever reached, and formed the subject of a most thrilling experience, which nearly had a tragic termination for both of the intrepid aërial explorers.

As the pioneer of systematic organisation of meteorological observations, the results of his endeavours may be seen in his weekly, quarterly and annual reports on the "Meteorology of England," contained in the periodical returns of the Registrar-General of Births, Deaths and Marriages for England and Wales during the long period of sixty-one years (1841-1902). He was a juror in the class of scientific and philosophical instruments at the exhibitions of 1851 and 1862, and, apart from his scientific work, was actively engaged in other useful spheres of labour.

He was a fellow of several of the learned societies. For upwards of half a century he was on the roll of membership of the Royal Society, to which he was elected on June 7, 1849, and from time to time he contributed papers to the *Philosophical Transactions*. In 1850 he was one of the founders of the British Meteorological Society—now the Royal Meteorological Society—and for many years took a leading part in the conduct of its affairs, being its original secretary, "who nursed it through its infancy and youth, and left it to other hands only when it was old enough and strong enough to walk alone" (president's address in the jubilee year). He was also a past-president of the Royal Meteorological Society, the Royal Microscopical Society, the Royal Photographic Society and the Aëronautical Society of Great Britain, a fellow of the Royal Astronomical Society, and for many years was on the executive committee of the Palestine Exploration Fund, of which he was for twelve years the chairman. He had also been honoured with the honorary fellowship of several foreign scientific bodies.

NOTES.

WE are fortunate in being able to publish the appreciative notice of the late Sir George Stokes's scientific work, contributed by Lord Kelvin to another part of the present issue. So long ago as 1875 (vol. xii.) Sir George Stokes was one of our Science Worthies, and the account of his career then given is now supplemented by the record of his life's work and estimate of its influence on scientific progress, which Lord Kelvin has sent us. The funeral at Cambridge on Thursday last was a striking ceremony, in which men of distinguished eminence in many branches of knowledge took part, as will be seen from the list given on pp. 345, 346, of some of the people present. It is but rarely that such an assembly is drawn together, and the presence of so many men of light and leading showed the high regard in which Stokes was held, and testified to a widespread desire to do honour to his memory. It is inexplicable that no attempt was made to find a place for the body in Westminster Abbey. Great by his works and personality, Stokes was a man whose memory the nation should delight to cherish, and if such men as he are not buried at Westminster, it is difficult to understand who should find a place there.

THE gold medal of the Royal Astronomical Society has this year been awarded to Prof. Hermann Struve, of Königsberg, for his work on the satellites of Saturn. The medal will be presented at the annual general meeting to be held to-morrow, February 13. The Councillor of the German Legation will attend the meeting and receive the medal for Prof. Struve, who is unable to be present.

A CENTRAL NEWS message from New York reports that earthquake shocks were felt on Sunday evening in Indiana, Illinois, Kentucky and Missouri.

A DESPATCH from Kingston, through Reuter's Agency, states that an earthquake with loud subterranean rumblings occurred in Western Jamaica during the evening of February 5.

ACCORDING to news from San Francisco, a hurricane and great wave struck the Society or Tahitian Islands and the Tuamotu Archipelago, 500 miles further east, on January 13. The hurricane lasted for several days, but it was most severe between January 14 and 16. Eighty islands are said to have been overwhelmed and 1000 natives killed. Native refugees at Tahiti state that the sky began to assume a peculiar aspect on January 11, and that the inhabitants were all greatly alarmed. The air was very oppressive, and the wind began blowing fiercely from the south-east. Hour by hour it increased in violence, and every wave was higher than its predecessor. The natives on several of the adjacent islands succeeded in making their way to Hikuera, which has the greatest elevation of all the islands in the group. A wall of water, said to have been at least forty feet in height, rose and rushed hundreds of miles wide through the islands. For ten hours this state of affairs prevailed. The storm extended to Raiatea in the Leeward Isles, where much damage was done, but no fatalities occurred. In connection with this disturbance, the earthquake records described by Prof. Milne on p. 348 are of interest.

THE *Daily Mail* announces that excellent telephonic communication was established on February 3 between the central State office in Copenhagen and Frankfort and Mayence in Germany, a distance of about four hundred miles. The Dutch Vice-Consul at Kallundborg, North-West Seeland, also spoke to Frankfort, every word being distinctly audible.

DR. A. S. GRÜNBAUM has accepted the post of director of cancer research at the invitation of the committee appointed to administer the fund initiated for that purpose by a gift of 10,000*l*. from Mr. Sutton Timmis, of Liverpool. The work will be carried on at the University College, Liverpool, and the Royal Infirmary.

WE learn from the *Athenaeum* that the King of Sweden and Norway has instituted a gold medal in honour of the centenary, last autumn, of the famous mathematician Niels Abel. The medal, which will be given by the Academy of Science in Christiania every fifth year, will be awarded for eminent work in pure mathematics, without regard to nationality.

MR. H. BALFOUR, the curator of the Pitt-Rivers Museum at Oxford, has been elected president of the Anthropological Institute for the year 1903. The council has selected for election as honorary fellows of the Institute, Mr. A. W. Howitt, of Melbourne, for distinguished services to the ethnology of Australia; Dr. F. von Luschan, for numerous contributions to ethnology; and Dr. Salomon Reinach, for his researches into the early history of civilisation in the Mediterranean and western Europe.

REMARKABLE results in the way of swift locomotion are said by the *Westminster Gazette* to have been obtained with the new Midland Railway compound engines, which for a distance of fifteen miles between Leeds and Carlisle attained a speed of more than eighty-two miles an hour, with a load of about 350 tons. The total weight of engine and tender is eighty-five tons, but the weight in working order is 112 tons. These engines are working express passenger trains between Leeds and Carlisle.

TO encourage investigations into the increase of fertility in soils by the action of bacteria and other micro-organisms, under the influence of mineral manures, with special reference to manuring with basic slag, the Berlin Association of Thomas's Phosphate Works has instituted a competition, with prizes amounting to a total of 1950*l*. Scientific essays and experiments conducted by practical farmers will be admissible in the competition. The competition is to be open to all, without regard to nationality. Competitors are requested to send in their essays, written in German, to the address of the association, Berlin, S.W., Hafenplatz 4, not later than February 1, 1906.

THE Berlin correspondent of the *Times* states that Dr. Sven Hedin delivered a lecture on February 7 to the Geographical Society of Berlin upon his recent journeys in Central Asia and Tibet. The Imperial Chancellor, Count von Bülow, who had intended to be present, was at the last moment prevented from attending. The Imperial Secretary of State for Foreign Affairs, Baron von Richthofen, appeared on behalf of the German Foreign Office. At the conclusion of the lecture, Prof. Hillman announced that the German Emperor had conferred on Dr. Hedin the second class with the star of the Prussian Order of the Crown. Dr. Sven Hedin was elected an honorary member of the Berlin Geographical Society, and was presented with the golden "Nachtigal" medal, which was founded in memory of a well-known Central African explorer.

THE United States Commercial Agent at Vladivostock states in a recent report that a German engineer has found new naphtha ground on the eastern part of Sakhalin Island, and also a large lake filled with dry naphtha. This, he says, would be excellent material for preparing asphalt. This engineer thinks the prospects for naphtha promise to be richer than those of Baku.

THE *Scientific American* gives an account of some experiments in wireless telegraphy which were recently carried out with a moving train, and proved very successful. Several difficulties peculiar to the case presented themselves; a vertical collecting wire could not be used, and horizontal wires inside the cars had to be substituted. It was also found that the receiving relay could not be used at its maximum sensitiveness on account of the vibration of the train. In spite of these and other minor drawbacks, it was found possible to keep the train in touch with the station for from eight to ten miles. The experiments were carried out by Dr. E. Rutherford and Dr. H. T. Barnes, of McGill University, Montreal.

DR. R. T. GLAZEBROOK, writing to the *Electrician*, states that the arrangements for carrying out photometric work at the National Physical Laboratory are now nearly completed. The photometric laboratory has been largely equipped by the generosity of Messrs. Crompton, who have presented a potentiometer outfit, the Electrical Power Storage Co., which is giving a battery of 150 cells, and Mr. Trotter and Sir Wm. Preece, who have presented other apparatus. A 10 c.p. pentane standard is being compared with that of the gas referees by Mr. Vernon Harcourt, and Mr. Glazebrook is in correspondence with the Reichsanstalt as to obtaining standard lamps. As soon as everything is in working order the laboratory will be able to assume the position and responsibility of a standard photometric authority, so far as this is possible without legislation. The establishment of this laboratory will be a great boon to electrical engineers, who will be able to look to it for guidance in some of the many vexed questions of photometry. The possibility of obtaining

a constant candle power incandescent lamp, such as that described by Prof. Fleming in his paper on photometry read before the Institution of Electrical Engineers, and of having it standardised by a competent and recognised authority, should act as an inducement to electrical engineers to pay more attention to the testing of lamps, and cannot fail to have a beneficial effect on the electric lighting industries.

We learn from a short notice in the *Scientific American*, translated from *l'Illustration*, that the dirigible balloon constructed for the brothers Lebaudy by MM. Julliot and Surcouf has been experimented on with continuous success. The start has been made in every case from a cemented trench in front of the shed. A number of ascents have been made with the guide rope trailing on the ground, and finally the rope was drawn up, though so arranged that it could be instantly thrown to the ground and caught by people who followed the balloon on foot. Even though a fog came on so heavily as to cause fear that the balloon would be pulled down by the weight of the condensation, a safe return to the starting point was made, and M. Juchmes then took charge of the balloon and caused it to describe a figure of eight with great dexterity. MM. Julliot and Surcouf propose to attempt the journey from Moisson to Mantes and back as soon as a fine day occurs.

Measurement of electric resistance has been employed by M. Lesage as a method of analysis for certain fermentations and in pathological cases. A note on these experiments is given by M. Dongier in the *Bulletin* of the French Physical Society (No. 188). Samples of Parisian milk were found at a temperature of 16°.7 to vary in resistivity between 230 and 275, but it was found that watering the milk increased the resistivity while lactic fermentation lowered it. The resistance of culture broths generally was affected by the growth of the bacilli. The tetanus bacillus lowered it, and this lowering was not due to the toxin; others raised it, some left the resistance unaltered. The serum of the blood of man and animals, taken from healthy adults, varied from 97 to 104 ohms at a temperature of 16°.7. Most diseases did not affect the resistivity, but some, notably typhoid fever, produced a noticeable increase, reaching to 117 ohms. The maximum in the case of typhoid occurred at the commencement of convalescence.

Dr. J. Mount Bleyer has sent us a copy of the introductory address delivered by him at the American Congress of Tuberculosis, on "Light—its Therapeutic Importance in Tuberculosis as Founded upon Scientific Researches." Barely ten of the eighty pages are devoted to the subject in question, the bulk of the communication being occupied by the consideration of the vibratory theory of light and its relation to other forms of motion familiar to every student of elementary physics. The fact that tuberculous patients are benefited by light is well known, and the author describes a method of treating consumptives by exposing them to sunlight in specially constructed solaria, and to the electric light from powerful arc lamps. He relies upon the violet and ultra-violet rays for his results, and maintains that they have the power of penetration, ignoring the fact that Finsen has proved that the red colouring matter of the blood prevents the passage of the radiations at the violet end of the spectrum. If the blood circulating in the lobule of the ear is sufficient to prevent the blackening of photographic paper, it is obvious that a very small proportion of the actinic rays can penetrate the lung, and it is known that to destroy bacteria, concentration of the actinic rays is necessary. The beneficial effect is probably due to the stimulation of the skin by the light rays and not to any direct influence upon the deeper tissues. The author does not, of course, rely upon light alone in the treatment of consumption, but combines with it "hygienic food, fresh air, exercise and such suitable remedies as are indicated." By a judicious combination of these measures, he claims that 75 per cent. of tuberculous patients are curable "to a certain extent."

The fourth volume (1901) of the *Publicationen der Kön. ung. Reichsanstalt für Meteorologie und Erdmagnetismus* contains an interesting summary and discussion of the lightning strokes that have been recorded in Hungary during the years 1890 to 1900. The author, Herr Ladislaus von Szalay, chief assistant of this institute, has written the text in two languages in parallel columns, so that those who cannot follow the Hungarian will probably be able to read the German. In his discussion of the observations, he treats of the distribution, frequency, periodicity, &c., of thunderstorms, and brings together a useful number of statistics relating to the same phenomena in other countries. A coloured map shows the geographical distribution of the thunderstorms, while an interesting diagram illustrates the eleven-year means of the frequency of incendiary flashes over 1000 square kilometres in Hungary. Full details, given in tabular form, of the thunderstorm records made at the several storm stations for the years 1896-1900 are added.

Herr von Szalay also contributes an interesting note on the peculiarity of lightning flashes to the *Meteorologische Zeitschrift* (Heft 10, 1902). He has found that the coherer of his instrument constructed to record the approach of thunderstorms was found sometimes to be quite insensitive to some flashes of lightning that were practically very near to it, while, on the other hand, it was in nearly continuous agitation during a distant storm when the sky overhead was cloudless. He relates that by watching the coherer and the lightning flashes simultaneously, he observed that flashes having sharp contours, whether from cloud to cloud or to the earth, agitated the coherer, but those that were diffuse were not recorded at all.

The United States Weather Bureau has issued its report for the year 1901-2. It need scarcely be said that the work, which contains 342 quarto pages, mostly tables, contains a large amount of very useful information. In addition to the results relating to the year in question, it includes a valuable series of tables, showing, for each month, the highest and lowest temperatures recorded in each State since the time observations were commenced. The work also contains monthly and yearly results for a number of stations in the West Indies. The weather forecasts and storm warnings appear to have been very successful, and an important recognition from the secretary of Lloyd's is quoted as to the accuracy of forecasts of bad weather issued for the North Atlantic Ocean. A programme of aërial research in the upper strata of the atmosphere has been inaugurated under the care of Prof. Abbe, and, further, a valuable set of nephoscope observations at eleven stations in the West Indies has been secured between May, 1899, and May, 1902; these observations furnish, for the first time, the necessary data for discussing problems connected with the circulation of the atmosphere in the tropical zone, and possess especial interest in connection with the distribution of the ashes ejected from the volcanoes in May and June last. Experiments on wireless telegraphy are being made; the opinion at present seems to be that for permanent communication between land stations, wire is the more trustworthy means of communication, and probably the more economical.

The current number of the *American Journal of Psychology* contains an elaborate experimental study of Fechner's colours (the colours of the "artificial spectrum top") by Miss F. W.

Bagley. The work was done, under Prof. Titchener's direction, in the psychological laboratory of Cornell University. Miss Bagley examines the effects of rate of rotation, length of black line, variation in size of sectors, width of line, position on the disc, contrast, intensity of illumination, colour of background, besides those of the general psychological factors, practice, attention and fatigue. She obtains particularly interesting results as regards the production of a subjective yellow and concludes that only a four-component theory of vision is adequate to her facts. The theory chosen, tentatively, is Ebbinghaus's modification of Hering's well-known hypothesis.

THE *Pioneer Mail* quotes a letter from a Ceylon paper in which a correspondent records killing a cobra that had partially swallowed a rat-snake. The cobra itself measured 4 feet 8 inches, and the disgorged rat-snake 5 feet.

WE have received vol. xx. part iv. of the *Schriften* of the Scientific Society of Dantsic. Among its contents is an illustrated account of the insects of West Prussia harmful to agriculture and horticulture, with suggestions as to the best means of combating their ravages.

THE fourth part of Prof. L. Bolk's important memoir on the anatomy of the Primates appears in part i. of vol. xxxi. of Gegenbaur's *Morphologisches Jahrbuch*. In this section the author describes in detail the cerebellum of the New-World monkeys. It is to be followed by an account of the same organ in the orang-utan.

DR. W. H. GASKELL, at the conclusion of a series of papers on the origin of vertebrates, published in the *Journal of Anatomy and Physiology*, summarises, in the January number, his views as follows:—"The consideration of the formation of the vertebrate cranial region indicates that the ancestor of the vertebrates was not an arachnid purely or a crustacean purely, but possessed partly crustacean and partly arachnid characters. In order to express this conclusion, I have used the term Protostraca, invented by Korschelt and Heider, to indicate a primitive arthropod group from which both arachnids and crustaceans may be supposed to have originated, and have therefore stated that the vertebrates did not arise directly from the annelids, but from the Protostraca."

IN the *Biologisches Centralblatt* for January 15, Herr E. Wasmann commences an account of an investigation into the phenomenon of "symphilism," that is to say, the harbouring of insects, &c., of various foreign species in the nests of ants and termites. It is stated that the number of symphilous arthropods exceeds a hundred, of which from eighty-five to ninety are beetles. All these symphilous insects, and more especially beetles, possess certain peculiarities by which they can always be recognised. Among the most notable are special exudation organs, such as pits or pores in the exoskeleton, mostly associated with pencils of yellow or reddish-yellow hairs. Moreover, most symphilous beetles have a characteristic colour, namely, oily reddish-yellow or reddish-brown. They also show certain modifications of the mouth-organs, especially of the labium, as well as "physogastrism," accompanied by excessive development of the fat-bodies, or sexual glands.

THE effects of natural selection and race-tendency upon the colour-patterns of the Lepidoptera formed the subject of an investigation recently undertaken by Mr. A. G. Mayor, the results of which are published in the *Science Bulletin* (vol. i., No. 2) of the Brooklyn Institute. It appears that the colour-markings of Lepidoptera consist of spots and bands, or of a combination of these two, the "combination-markings" being the least frequent. Certain general types of variation in these markings are noticeable, but each family or genus has characteristic modifications of these types of variation. A definite relation exists between the number of markings on the fore- and the hind-wings. The species of a genus and the genera of a family are differentiated by modifications of certain dominant conditions, each genus or family displaying its own dominant conditions and following its own peculiar law of differentiation. On the whole, the investigation favours the view that new species have originated by mutation independent of environment, and generally not interfered with by adverse selection.

PROF. POTONIÉ, in a small work published by Gustav Fischer, gives an explanatory account of his pericaulom theory of the structure of plants. Probably the author would hardly accept as a description of his position the suggestion that it is an attempt to combine the views of Goethe and of Alex. Braun, but it seems nevertheless very much like it. The plant is conceived of as primarily originating from a dichotomising thallus, which gradually becomes, by unequal development of the two limbs, a sympodium. The leafy part seems to be formed as the outward prolongations of the terminations of the dichotomising arms. The theory is complicated by notions of congenital concrescence, but it does not seem to render the task easier of deciding as to what parts are to be attributed the properties of "Leaf-nature" and what "Stem-nature." He concludes (p. 40), on grounds that will probably not satisfy all anatomists, that in the highest plants the pith is to be regarded as the "urachse," the peripheral tissues belonging to the "pericaulom." It may be doubted whether these academic speculations will appeal to many botanists at the present day.

A SUBJECT list of the works on general science, physics, sound, music, light, microscopy and philosophical instruments, in the library of the Patent Office, has been issued at sixpence. The list consists of two parts: a general alphabet of subject headings (occupying 170 pages), with entries, in chronological order, of the works arranged under these headings; and a key (12 pages) or a summary of these headings, which serves the purpose of an index.

THREE more volumes of the first annual issue of the "International Catalogue of Scientific Literature" have reached us. Volume v. contains astronomical works and runs to 301 pages. Volume vii. deals with pure mathematics in 201 pages, and volume viii. with bacteriology in 314 pages. Those portions of the literature of 1901 which are not catalogued in the volumes of pure mathematics and bacteriology will form a part of the second annual issue of the catalogue.

MESSRS. JOHN BARTHOLOMEW AND CO., Edinburgh, have commenced the publication, in twenty one monthly parts, of "The Survey Atlas of England and Wales." The atlas is to contain eighty-four plates of maps and plans, with descriptive text, illustrating the topography, physiography, geology, climate, and the political and commercial features of the country. The maps have been designed and prepared under the direction of Mr. J. G. Bartholomew. The basis of the atlas is the Ordnance Survey, reduced, by permission, to the uniform scale of half-an-inch to the mile, in sixty-seven section maps, which are coloured according to contour lines. In order to correct the maps to date, the sheets have been submitted to local authorities for systematic revision, and the general maps have also been revised by specialists.

PROF. A. M. WORTHINGTON'S "Dynamics of Rotation," which was written several years ago to provide engineering

students with an elementary treatment of rigid dynamics, and was reviewed in NATURE of May 5, 1892 (vol. xlvi. p. 4), has so successfully fulfilled its purpose that it is now in its fourth edition. In this edition the author directs special attention to the use of the "inertia skeleton," in which a body is replaced by a dynamically equivalent system of three thin wires placed along the three principal axes at its centre of mass. This method of representation has been found to appeal to non-mathematical students far better than the conventional momental ellipsoid. Further attention has also been given to experiments with a gyroscope, which are so easily made that it is a matter for congratulation that they can now be studied in an elementary treatise. The author introduces the name "slug" to denote the mass to which a foot-pound unit of acceleration is produced by a gravitation unit of force.

ACCORDING to recent investigations, liquid sulphur dioxide is a solvent in which a large number of substances, organic and inorganic, are readily soluble. From experiments of Walden and Centnerszwer, published in the *Zeitschrift fur physikalische Chemie*, it appears that sulphur dioxide forms complex compounds with many of these substances. From solutions of potassium iodide in liquid sulphur dioxide, they have obtained a crystalline compound of the formula $KI.4SO_2$, which melts at $+0°.26$ C. Similar compounds are in all probability formed by other salts, and the name of "sulphones" is ascribed to this class of bodies.

IN the current number of the *Zeitschrift für physikalische Chemie* is a noteworthy paper by Messrs. Alexander Smith and W. B. Holmes in which the nature of amorphous sulphur is discussed. This so-called amorphous sulphur is formed when liquid sulphur is maintained in the molten condition for some time, and its amount increases as the temperature is raised. A method of determining the proportion of amorphous sulphur in the liquid variety has been worked out which depends essentially on the great difference in solubility of the two forms in carbon bisulphide. From parallel determinations of the proportion of amorphous sulphur and of the freezing point of the melt, it is shown that the lowering of the freezing point below 119°.25 C. is proportional to the quantity of the dissolved amorphous sulphur. The molecule of the latter in the solution of the soluble liquid form is found to be represented by the formula S_8.

A NEW reducing agent which promises to be of considerable service is described by Mr. E. Knecht in the current number of the *Berichte*. From the analogy between titanium and tin, it appeared likely that the chloride of titanium on reduction would give a lower chloride $TiCl_2$, analogous to stannous chloride. The reduction of the acid solution of the tetrachloride of titanium, however, produced the trichloride already known instead of the expected dichloride, but this, on examination, proved to possess remarkable reducing properties. Whilst applicable to reduction in a similar manner to stannous chloride, titanium trichloride is more powerful. Copper salts can be reduced to metallic copper; sulphites may be quantitatively reduced to hyposulphites, or, if the action be pushed, sulphur is produced. By careful neutralisation with soda, the titanium can be completely removed as the hydrated oxide. The behaviour of titanium trichloride towards organic substances is also of interest; nitro-bodies are reduced immediately to amines, and in the case of substances containing more than one nitro group, the partial reduction is readily effected. Azo-bodies are attacked so sharply that they may be quantitatively estimated, and other reactions are given showing the wide range of applicability of this reagent.

SOME time ago it was shown by M. C. E. Guillaume that it was possible to obtain nickel steel alloys which possessed extremely low coefficients of expansion, and in the current number of the *Comptes rendus* he gives a more detailed study of the conditions necessary to obtain such alloys. The expansion is influenced considerably by the presence of foreign elements such as manganese, carbon and silicon, and it has been found that if these are reduced below a certain amount, the alloy cannot be worked. Working under the most favourable conditions, an alloy has been obtained possessing a coefficient of expansion $\alpha = (+0.028 - 0.00232\theta)10^{-6}$, a figure which can be better understood when it is stated that a wire made of this steel, one kilometre in length, would alter in length in passing from 0° to 20° C. less than 0.4 mm. The importance of an alloy possessing such properties in geodetic work is obvious, and extensive use has already been made of it in the geographical service of the French army, in the marine hydrographical service and elsewhere. All temperature corrections in geodetic work become superfluous.

THE additions to the Zoological Society's Gardens during the past week include a Barnard's Parrakeet (*Platycercus barnardi*) from Australia, presented by Mrs. Jebb; a Hawfinch (*Coccothraustes vulgaris*), British, presented by Miss H. Brown; a Rufous Rat-Kangaroo (*Aepyprymnus rufescens*) from New South Wales; two Corean Cattle (*Bos taurus*, var.) from Corea, six Proteus (*Proteus anguinus*) from the Caves of Carniola, deposited.

OUR ASTRONOMICAL COLUMN.

ELEMENTS AND EPHEMERIS OF COMET 1903 *a*.—The following elements and ephemeris for this comet have been calculated, by M. G. Fayet, of Paris Observatory, from observations made at Nice (January 19), Besançon (January 24) and Paris (M. Bigourdan, January 27); the necessary corrections for aberration and parallax have been made.

T = 1903 March 28.9468 M.T. Paris.

$$\left.\begin{aligned} \omega &= 130^\circ\ 40'\ 55'' \\ \Omega &= \ \ 0\ \ 41\ \ 56 \\ i &= 35\ \ 35\ \ \ 6 \end{aligned}\right\} 1903.0$$

$$\log q = 9.67479$$

Ephemeris 12h. M.T. Paris.

Date.	α app. h. m. s.	δ app. ° ′	log *r*	log Δ	Brightness.
Feb. 9 ...	23 24 50	+ 8 7.1	0.0619	0.2517	2.1
13 ...	23 31 17	+ 9 27.7	0.0348	0.2395	2.5
17 ...	23 38 16	+10 53.7	0.0056	0.2257	3.1
21 ...	23 45 49	+12 25.1	9.9742	0.2101	3.8
25 ...	23 54 3	+14 2.5	9.9403	0.1923	4.8
March 1 ...	0 3 2	+15 45.5	9.9039	0.1721	6.3

The brightness on January 19 (about 10m.0–11m.0) is taken as unity (*Astronomische Nachrichten*, No. 3845).

THE CONSTANT OF ABERRATION AND THE SOLAR PARALLAX.—In No. 529 of the *Astronomical Journal*, Dr. Chandler gives the results of an exhaustive inquiry, which he has conducted during the last ten years, into the various values obtained for the constant of aberration by different observers and methods. After discussing the trustworthiness of the methods employed, Dr. Chandler apportions various weights to the results obtained, and then rejects a number of these results as being too uncertain. He then determines the constant from the accepted results, and obtains, as the general mean, the value 20″.521 with a probable error of ± 0″.005.

In order to show the effect of incorporating *all* the results, he determines the weighted mean of all the values and thereby obtains the value 20″.517.

As a final result of the inquiry, Dr. Chandler accepts the value of 20″.52 for the constant of aberration, and this produces the value 8″.78 for the solar parallax.

A NEW FORM OF SPECTROSCOPE.—In No. 12, vol. xxxi.,

of the *Memorie della Societa degli Spettroscopisti Italiani*, Signor Antonio Sauve describes a new form of spectroscope which he has devised and calls the "Filtro Spettroscopico."

This instrument enables an observer to view directly, or to photograph, the monochromatic image of any object which emits light of the desired wave-length.

Among the various observations for which the author suggests the instrument may be used, he includes the observing of prominences and other solar phenomena, and claims the following advantages for his method over the methods now practised:—(1) The prominences on the *whole* of the solar disc may be observed visually, and (2) the surface may be observed, visually or photographically, as a whole, instead of having to be taken in sections as is done at present.

REPORT OF THE UNITED STATES NAVAL OBSERVATORY.—This comprehensive report deals with the work done during the fiscal year ending June 30, 1902, and is full of interesting descriptions of the methods employed and the results obtained.

A large diurnal temperature change in the azimuth constant of the 6-inch transit circle has been eliminated by substituting brick and Portland cement piers for the marble piers on which the instrument formerly rested.

With the 26-inch equatorial, important work has been done in determining the diameters of the planets and their satellites, and, by comparing the diameters obtained at night-time with those obtained at twilight, the constants of the variations due to irradiation have been determined. The results are given in a complete and interesting table. The value for irradiation in the case of Mars varies from 0″·70 when the planet is in aphelion to 1″·02 when it is in perihelion, and should, therefore, always be taken into account in observations made at different epochs.

During the year, photographs of the sun were obtained with the 40-feet photoheliograph on 200 days, and these showed the presence of spots on 45 days. Although the average number of spots for the whole year is less than during the previous year, the average frequency from October to July is slightly greater, thus indicating that the sun-spot minimum has probably been passed.

Reports on the 12-inch equatorial, the prime vertical transit instrument and 5-inch altazimuth, the magnetic and meteorological sections, and several other instruments and departments are also given in detail.

A NEW 18-inch refractor is being made by Messrs. Alvan Clark and Sons for Amherst College Observatory.

WE are pleased to learn that the recent fire at Yerkes did no injury to the 40-inch refractor, but some damage was done in the coelostat room.

FORESTRY IN THE UNITED STATES OF AMERICA.

TWENTY years ago, the people of the United States did not trouble themselves much about their forests. It was said that enormous areas were stocked with an inexhaustible amount of timber and fuel. Since then a great change has taken place. It has gradually been ascertained that, although the total forest area is estimated at about 700 million acres, the average stand does not amount to more than about five tons per acre, which is equivalent to about one-tenth of what it would be in systematically managed forests; in other words, the stand of timber in the United States forests is equal to the stand in about 70 million acres of forests such as are to be found in Germany and a great portion of France. Since it has been ascertained that the actual cuttings of timber in the United States exceed already 100 million tons a year, it follows that the present stand must be used up in about thirty years. Nor is the quantity removed annually from the forests replaced by new growth, as the latter has been estimated to amount to about 75 million tons. Moreover, it must not be forgotten that the annual forest fires destroy enormous quantities of material.

As already stated, these matters began to attract attention some twenty years ago. Thoughtful people wrote about them, societies were formed, information collected and made available to the general public. The State Governments issued regulations so as to prevent further destruction by fire, and they established certain State parks. Nor did the Federal Government neglect the matter. A Chief of the Forestry Division of the Agricultural Department was appointed, Mr. Fernow, who got together statistics and spread sound ideas regarding the rational treatment of forests. He was succeeded, a few years ago, by Mr. Gifford Pinchot. The latter went, about fourteen years ago, to study forestry in Germany and France. After his return to America, he set up in New York as a "consulting forester" (though a very wealthy young gentleman). Mr. George Vanderbilt engaged him to manage his forests at Biltmore, now amounting to more than 100,000 acres, having for his object to see whether systematic forestry can be made to pay in the States. In this post Mr. Pinchot was succeeded, about eight years ago, by Dr. Schenck, a first-class German forester.

When Mr. Fernow left his post at Washington, he became Professor and Dean of the Faculty of Forestry at Cornell University, endowed by the State of New York with money, and 30,000 acres of forest lands in the Adirondacks for systematic management and practical instruction. Soon after Mr. Gifford Pinchot took up the post at Washington, he and his family presented Yale University with the sum of 30,000*l*. for the purpose of endowing a second forest school in connection with the University; they also established a summer school for the study of forestry by those who could not afford to proceed to a regular degree at the University. According to the report for 1901–2, there were thirty-one students of forestry at Yale University and twenty-seven attending the summer school.

At Biltmore, Dr. Schenck has established a third forest school, where, on October 1, 1902, sixteen students were in attendance. I had on two occasions the pleasure of conducting students of this school through some of the most interesting forests of south Germany (seven in 1900 and six in 1902), these young gentlemen having, at the conclusion of their course at Biltmore, come to see something of systematic forest management in Europe.

Apart from the above three higher schools, forestry is now taught at about forty other educational establishments in the United States. In this way, quite a respectable number of well-trained forest experts has become available, in addition to about half-a-dozen young men who followed Mr. Pinchot's plan and studied in Germany.

The Federal Government has, by degrees, inaugurated a systematic forest policy, progress having been specially rapid since Mr. Pinchot became head of the Forestry Bureau. An area of 46 million acres of Government land has been declared (chiefly in Mr. Cleveland's time) "reservations," by Presidential proclamation. These areas are situated in the west. And now President Roosevelt has sent a message to the Senate and House of Representatives recommending a national forest reserve of considerable extent in the Southern Appalachian region, this measure being, as he states, "an economic need of prime importance to the welfare of the south, and hence to that of the nation as a whole."

Another matter vigorously taken up by the Bureau of Forestry is the preparation of rational working plans for private forests. A considerable number of field assistants have been engaged, who are sent out to prepare working plans for the forests of such private proprietors as apply for them. So great has been the demand in this respect that, although last year plans were prepared for more than one million acres, the field assistants could deal with only about one-tenth of the applications received at the head office.

All the while, the collection of statistics and dissemination of useful information proceeds at a most rapid rate. In this respect I may mention that I have during the last three months received the following reports and pamphlets:—

(1) "The Timber Resources of Nebraska," by W. Hall, Superintendent of Tree Planting, Bureau of Forestry.

(2) "Grazing in the Forest Reserves," by Filibert Roth, of the United States Department of the Interior, in charge of the work in the Government forest reserves.

(3) "A Working Plan for Southern Hardwoods and its Results," by J. Foley, Field Assistant, Bureau of Forestry.

(4) "A History of the Lumber Industry in the State of New York," by Colonel W. Fox, Superintendent of Forests, New York State.

(5) "The Western Hemlock," by G. E. Allen, Field Assistant, Bureau of Forestry.

(6) The above-mentioned message by President Roosevelt, transmitting a magnificent volume of reports on the forests, rivers and mountains of the Southern Appalachian region.

(7) "First Book of Forestry," by Filibert Roth. This little elementary book is most charmingly written, giving in simple terms, and in an attractive form, the first principles of forestry. Although the illustrations are taken from species growing in the United States, I can strongly recommend the little book (published by Ginn and Company, pp. 261, price 3s. 6d.) to landed proprietors and foresters in this country.

I have no doubt that these publications form only part of those which have lately appeared. All show signs of a good grasp of the subject, and prove the vigour with which it has been taken up. As already indicated, the forests of the United States are at present worked under a heavy deficit, as compared with production. This deficit will increase with the growth of the population and the further development of the industries of the country, and this will go on until a sufficient area of forests has been placed under systematic management. That measures to bring this about have not been taken a day too soon will be evident when it is considered what the requirements of the country are. Not only are enormous quantities of wood fuel wanted for a population of some 80 million peoples, but timber in proportion is required for pulp wood, posts, railway ties, poles for telegraphs and for piling, mining timber, ship timber, cooperage and wagon timber, lumber generally, and for many other purposes. To give an idea of what the total requirements may amount to, I shall pick out one or two items. There are upwards of 200,000 miles of railways in the States, which require annually some 70 million railway ties. To keep up this supply, some 8 to 10 million acres of well-managed forests are wanted. The annual requirements of general lumber are at present estimated at 30 billion feet, board measure, requiring not less than some 100 million acres of forests to keep up the supply. The demands for pulp wood and mining timber are already enormous, and likely to increase. The exports of timber from the States amount to a little more than one million tons a year, and these are already considerably exceeded by imports from Canada.

On the whole, then, the reservations made up to date can be considered only as a moderate beginning in the right direction. To meet the future requirements of the nation, the present area of reservations must be largely increased and they must all be brought under systematic protection and management. However, the people and the Government are evidently determined to do what is necessary, and their efforts up to date bear testimony to the energy with which any question bearing on the general welfare of the nation is taken up and carried through.

Can we in this country not learn a lesson from the above facts, as we have been obliged to do in more than one other respect of late years? Our timber imports have latterly grown very rapidly, far more so than the increase of the population, while the sources of supply are becoming more and more precarious. It is all very well to say that we can pay for the imported timber, but what when the sources of supply fail? And all this time we have some 13 million acres of waste land and some 12 million acres of mountain and heath land used for light grazing in these islands, or a total of 25 million acres which yield a very small return or none at all. One-quarter of that area put under forest and treated in a rational manner would supply all the timber we require (apart from limited quantities of tropical timbers) and keep some 25 million pounds sterling in the country which we now send abroad every year to pay for the imported timber. And how many of the unfortunate unemployed, who are becoming the nightmare of our city authorities, would not find healthy employment in the country if a real effort were made to grow our own timber at home?

W. SCHLICH.

THE ELECTROCHEMICAL SOCIETY.

LAST March a few of those interested in the advancement of the study of electrochemistry in this country held a meeting in London. After some discussion as to the best means of advancing the object which it had in view, the meeting unanimously agreed to endeavour to form a society of electrochemists. A small committee was then appointed, which, after holding several meetings, sent out circulars to those who it was thought would be interested in the formation of such a society. A considerable number of favourable replies was received, but some who wrote deprecated the idea of adding yet another to the already large number of scientific societies. The committee then approached several existing societies, in order to see whether it might not be possible to work in conjunction with one or other of them. But although the replies received were couched in friendly terms, none of these societies seemed inclined to make any special effort to help forward the movement.

In these circumstances it was decided to call a general meeting of supporters of the movement to inaugurate an Electrochemical Society. By the kind permission of the committee of the Faraday Club, the meeting was held in the club rooms at the St. Ermin's Hotel, on the afternoon of February 4.

Mr. Swinburne, chairman of the committee, took the chair, and briefly reviewed the circumstances which had brought the meeting together. He emphasised the importance of the electrochemical industry abroad, and pointed out how exceedingly backward we are in this country. Mr. Swan, in a brief speech, then proposed the formation of the society, and said that there was no doubt but that it would be of great scientific and commercial value. Mr. Alexander Siemens seconded the motion, which was carried unanimously.

Mr. Swinburne then read out a list of those who had been nominated by the committee and had expressed their willingness to serve on the council of the society. Mr. Swan, F.R.S., was elected president, the vice-presidents being Lord Kelvin, Prof. Crum Brown, F.R.S., Sir Oliver Lodge, F.R.S., Lord Rayleigh, Mr. Ludwig Mond, F.R.S., Mr. Alexander Siemens and Mr. J. Swinburne. The committee's recommendations were unanimously endorsed, and after a short discussion, and a vote of thanks to the committee of formation, the meeting separated.

The youngest of scientific societies in the country started off with a promised membership of 150. There is, however, very little doubt but that in a short time many more, who have only been waiting for the movement to become an assured success, will join. Already since circulars calling the meeting were sent out, several who in the first place refused their support have sent in their names for membership.

The science of electrochemistry, which was initiated in this country through the splendid work of Davy and Faraday, has been allowed to languish, and but little attention has been paid to its great advancement abroad. In Germany a flourishing society, which issues a weekly journal, has been in existence for more than eight years. The Americans have a very vigorous society, which was established last year. The British society has been established with the object of advancing both pure and applied science. One is often met by the cry that electrochemical industry is all very well in countries where there is plenty of cheap water-power, but that it will never be a success when you have to depend upon coal as an initial source of energy. But there is such a source of power as the Mond gas, and gas engines are every day becoming more perfect. Again, coal is cheaper in this country than in most places where there is an abundance of water-power. In some directions we may be handicapped; to a large extent this is due to our own inertness—our great chemist, Faraday, laid the foundation-stone of electrochemical science—we have left it to others to build thereon. But the building is not complete; indeed, it may require to be partially pulled down and rebuilt. The Electrochemical Society has been formed to rehabilitate the science in this country, and its promoters look forward with the sanguine hope that when the scientific history of the next decade is written, British discoveries and inventions in the domain of electrochemistry will not be behind those of any other country.

All interested in electrochemistry and physical science and who are willing to help forward this society should send in their names to Mr. F. S. Spiers, Grosvenor Mansions, Victoria Street, Westminster.

AGRICULTURAL NOTES.

IN a shilling pamphlet published at the offices of the *Mark Lane Express*, Mr. W. J. Malden, of the Colonial College, Hollesley Bay, discusses the merits of ten new "potatoes with money in them." Hundreds of new varieties have been raised in the past few years, but nearly all of those named in the pamphlet have been produced by one grower—Mr. Findlay, of Markinch—and this fact indicates that to raise valuable new

kinds very special gifts are necessary. On the other hand, the developing of new sorts already on sale in limited quantities is much less difficult, and Mr. Malden shows that handsome profits may be made by those who are shrewd enough to recognise the coming varieties. Last year, for example, the kind known as "Northern Star" was selling at 10*s.* per lb.; this season the price was 5*s.* per lb., but it has now advanced to 15*s.* The tubers exhibited at the Smithfield show were priced at 7*s.* 6*d.* each! By growing plants from a single "eye" under garden conditions, the produce may be increased a hundredfold in one season. Thus Mr. Malden produced 168 plants and 418 lb. of tubers from 4 lb. of "setts" planted in the spring of 1902. At the present time, there are a number of first-class kinds awaiting development, and it is to be hoped that Mr. Malden's remarks may induce a larger number of farmers and gardeners to give attention to the subject. From the public standpoint, it is much to be desired that good new sorts should be rapidly multiplied and brought into the vegetable market.

A simple demonstration conveying a useful lesson to the farmer has just been carried out at the new Harper-Adams Agricultural College, Shropshire. Seven cwt. of an ordinary compound manure (a "special turnip manure" sold at 6*l.* 15*s.* per ton) was applied to an acre of roots; to a second acre, the same quantity of plant food was given in the form of a mixture of superphosphate and sulphate of ammonia, followed by a top-dressing of nitrate of soda. The cost of the special manure was 47*s.* per acre, of the other 27*s.* 9*d.* The result, as was anticipated, was an almost equal yield of roots, and a saving by using the home-mixed manure of 1*l.* per acre. This demonstration wants repeating in every county, for there are two classes who have not yet learned to assess "special" manures at their real value—manure manufacturers and farmers.

Under the suggestive title of "A new Departure in the Science of Fattening," Mr. Warington contributes a valuable paper to the *Agricultural Students' Gazette* (Cirencester). He discusses the recent work of Kellner on the feeding of farm animals, with special reference to the comparative effects of such fibrous fodders as hay and straw in the fattening of cattle. Agricultural chemists have held that the digestible nutrients in fodders of a similar character, such as oat and wheat straw, must have a similar value for the fattening animal, and they have argued that the comparative value must be shown by the composition. Practical agriculturists, on the other hand, hold that the chemical composition is not a correct index of the fodder's value, and they have never attached much weight to their scientific advisers' opinions of common farm foods.

The recent work of Zuntz (Berlin) and Kellner (Möckern) has shown that the farmer's opinion is correct and that a chemical analysis does not indicate the relative values of fodders grown under different conditions. The mechanical as well as the chemical composition has an important influence on the effects produced by a food on the fattening animal. A hard or tough straw requires more energy for its digestion than a softer one, this energy becomes a first charge upon the food, and thus the "efficiency" of an indigestible food is lower than that of a digestible one of the same chemical composition. It has, of course, been known that digestion involves an expenditure of energy, but Zuntz and Kellner have been the first to show how great the effect of this may be on the value of a fodder.

The former worker so long ago as 1896 wrote a paper for the *American Experiment Station Record* in which he discussed this question, pointing out that in the case of the horse the nutrients assimilated from hay yielded 20 per cent. less available energy than the same nutrients assimilated from grain; but the importance of Zuntz's work does not seem to have been appreciated in this country. Kellner's experiments are, however, likely to arouse widespread interest. He has compared the effects produced on fattening oxen by nutrients derived from various sources, and among other results he finds that to produce the same increase as is due to 100 lb. of starch it is necessary to supply 147 lb. digestible nutrients in meadow hay, 157 lb. in oat straw, and no less than 374 lb. in wheat straw. The figures, of course, hold good only for the particular samples of hay and straw used by Kellner; the importance of the result lies in the fact that a wide variation in value has been proved. Kellner's experiments may not, perhaps, affect the rations given by the farmer to his cattle, but they will very greatly affect the rations which he (the farmer) has hitherto been *recommended* to use.

The December number of the United States *Experiment Station Record* contains a short report of the sixteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations. Among the papers read was one which emphasised the importance of breeding and selecting corn for different purposes, showing how much the market value might be affected by slight variations in the composition. The composition of the grain of cereals is a subject to which our English seed growers have hitherto given little attention. Wheat, for example, has been selected for appearance, for yield and for stiffness of straw, but the chemical composition has been neglected, with the result that the miller and baker condemn our present English wheats as inferior and unsuitable for flour-making. We grow about one-fourth only of what we consume, but so small is the proportion of home-grown wheat which millers can profitably mix with imported grain that the markets are often glutted with English wheat which millers will not buy. A very slight alteration in the chemical composition would enable millers to employ profitably 35 per cent. to 40 per cent. of English wheat in their mixtures, instead of 25 per cent. to 30 per cent. as at present, and would thus remove the possibility of glutting the market with English wheat. In ten or fifteen years time, we may hope to see this change in composition effected. In the meantime, it would be interesting to follow the lead of the American writer, trace the effect of composition on market value, and investigate the loss the nation has suffered in the past decade or two and must continue to suffer for years to come from this oversight on the part of our seed growers. T. H. M.

WEST INDIAN NOTES.

The third number of vol. iii. of the *West Indian Bulletin*, issued by the Imperial Agricultural Department, contains a large amount of information on a variety of subjects. Mr. Francis Watts deals with "Raw Sugars for Brewing Purposes," Mr. P. C. Cork with "Stock Rearing in Jamaica," Mr. Maxwell-Lefroy with "Scale Insects of the West Indies," &c. A lengthy account, 23 pages, of the volcanic eruptions in the West Indies includes a reproduction in full of a most interesting series of observations taken by the Rev. N. B Watson, at his residence, about twelve miles east of Bridgetown, Barbados, from 5 a.m., October 14, to 6 a.m., October 17, covering the period of the Soufrière eruption in St. Vincent on October 15–16 and the dust fall in Barbados. Careful notes were taken of the direction and force of the wind, temperature, clouds, aspect of the sun, sky, the atmosphere, &c., and the rate at which the dust fell was frequently measured, the heaviest being 38·1 grammes per square foot, from noon to 1 p m. on October 16.

The Department has also just published Nos. 19 and 20 of its pamphlet series, dealing with seedling and other canes at Barbados and in the Leeward Islands respectively. Of the large number of varieties of seedlings experimented with, the results for the past season show B. 208 to be the best all-round cane, beating all its rivals in Barbados, Antigua, St. Kitts and Trinidad. In Barbados, its juice was described as "exceedingly rich and pure," in Antigua as "exceptionally rich in sugar," and in St. Kitts as "of remarkable richness and purity." Part i. of the report on the sugar-cane experiments conducted at Antigua and St. Kitts in the season 1901–02, published at the same time, contains the complete statistical results for the two islands.

The report on the Antigua Botanic Station for the year ending March 31 last contains full particulars of the working of a "Peasant's Garden," in which nothing is done that cannot easily be accomplished by a working man having a similar small piece of land. In the previous year, the experimental plot was one-tenth of an acre; it required an expenditure, for labour, seeds and manure, of 1*l.* 15*s.* 3*d.*, and the varied produce, when sold, fetched 2*l.* 15*s.*, leaving a profit at the rate of nearly 10*l.* per acre. Last year the area was increased to one-seventh of an acre; the expenditure was 3*l.* 11*s.*, and the produce realised 4*l.* 16*s.* 11*d.*, showing a profit of about 9*l.* per acre. In re-afforestation experiments, about a dozen varieties of trees were being tested, the best growing being found to be mahogany and white cedar. It is curious that, while in neighbouring islands sugar-cane seedlings have been successfully raised, the several attempts made in Antigua have almost invariably turned out failures, very few fertile

seeds being, apparently, produced. Carefully selected arrows from different varieties have produced only about twenty germinating seeds, and of these only four seedlings have been saved and planted out. This is the total result of many trials in the island.

Reviewing agriculture in the West Indies in 1902, the official *Agricultural News* states that solid success attended the efforts to establish industries other than sugar in some localities, the progress made in onion cultivation standing out conspicuously. Both Antigua and Montserrat were able to export considerable quantities of onions, and Dominica and Barbados made satisfactory starts in cultivation. Cotton growing also showed substantial progress, a considerable acreage being under cultivation in Montserrat, St. Lucia and Antigua. At St. Lucia, cotton was grown on 105 acres last year, the whole southern seaboard, about forty-five square miles, being considered excellent soil for cotton, where it can be grown at about one-fourth of the cost of sugar-cane.

TECHNICAL EDUCATION AT HOME AND ABROAD.[1]

A NATION'S view of the expected outcome of its system of education is frequently shown by the recurrence of a typical question. Thus a Frenchman, when considering a young man's qualifications, will naturally ask, What examinations has he passed? A German will ask, What does he know? An Englishman will inquire, What kind of a fellow is he? An American will ask, What can he do? These varied questions reflect the form of education in vogue. In them we see the French tendency to formalism, the German disposition to over-intellectualise their schools, the English love of an all-around gentleman and the American fondness for achievement.

Since the close of the Franco-Prussian war, the development of Germany has been remarkable. Hamburg has risen from the sixth largest port in Europe to nearly the first; German cottons are sold in Manchester, German steel in Sheffield and Leeds, German silks in Paris, and "Made in Germany" is a familiar mark to us. From 1875 to 1895, the population increased from 45,730,000 to 52,250,000. The working energy, during the same period, increased from twenty-five to more than forty-six million foot pounds daily, or about four times as fast as the population. Between 1889 and 1896, the exports from Germany to China increased 86 per cent; to Japan 92 per cent. The tonnage of German vessels trading with these countries has trebled since 1886. The number of German steamers in 1871 was one hundred and fifty; in 1897 this number had increased to eleven hundred and twenty-five. During the same period, the tonnage increased from 82,000 to 900,000. That Germany has been successful in a commercial way during the past thirty years is not to be denied. Her success can be traced to her belief in the industrial value of scientific research and to her fostering care of the technical education of her people.

From an examination of special industries, we can obtain a clearer idea of this influence. Consider the beet sugar industry. In 1840, 154 000 tons of beets were treated, yielding 8000 tons, or $5\frac{1}{2}$ per cent. of raw sugar. In 1899, with improved scientific processes, 12,000,000 tons were crushed, yielding 1,500,000 tons, or 13 per cent. of raw sugar. This increase of yield from $5\frac{1}{2}$ to 13 per cent. is the direct result of the work of technical men in control of the industry. Not only is Germany no longer dependent upon the West Indies for her sugar, but in one year she has sold Great Britain fifty million dollars worth. The manufacture of alcohol from potatoes is another lucrative field for German technologists. The cost has been reduced to about 25 cents per gallon, and experiments are in progress to determine its efficiency as fuel on steamers. The manufacture of artificial indigo by a chemical process was discovered in Germany in 1866. Less than forty workmen were then employed; now more than six thousand men and a staff of one hundred and forty-eight scientific chemists are employed in the industry. The natural indigo is almost driven out of the market. They have also discovered a method for obtaining from steel processes ground slag which is used as a fertiliser; and England, although she produces quite as much steel as Germany, has become a good customer for the article. Recently there came the discovery, by a chemist, named Giebler, of a process of hardening steel which makes it, it is said, 14 per cent. stronger, 50 per cent. lighter and one-third less costly than the Krupp or Harvey steel. Twenty-five years ago, the English and French makers of scientific instruments of precision were far in advance of the German. However, through the organisation of the Reichsanstalt, an institution for original research and the standardising of instruments, supported by the Government, Germany has become the manufacturer of the best scientific instruments in the world. The value of her exports in this line is nearly 2,000,000 dollars, three times what it was fifteen years ago, and the work gives employment to 15,000 people.

The Germans are fully alive to the necessity of being well prepared to engage in the struggle for industrial supremacy. Prince Bismarck once said: "The war of the future is the economic war, the struggle for existence on a large scale. May my successors always bear this in mind and take care that when the struggle comes we are prepared for it." Bismarck's behest has been heeded. The Germans, by dint of long and thorough preparation, are ready for an economic war. For more than thirty years they have been preparing, and we can see in all directions the steps that have been taken to improve the technical sides of education, so as to produce men who are capable of carrying Germany to the front in this industrial and commercial struggle. The system of German technical schools comprises first a group of Technischen Hochschulen, situated at the capitals of the German States, like those of Berlin, Dresden, Munich and Carlsruhe. These are of the very highest grade, admitting only students who have completed a Gymnasium or Realschule course of study. They have without exception developed gradually from mere trade or building schools. Most of them were founded in the twenties and thirties of last century, and one—the Charlottenburg—was founded as early as 1799. These schools are all beautifully housed, have superb equipments, and are doing a high grade of professional engineering work. Next below them in educational rank comes a great number of trade schools, like the Textile School of Crefeld. These trade schools are located at the centre of the industry to be benefited and are distinctly utilitarian in character. Besides these, there are many continuation and manual training schools. So numerous are these specialised schools that a German can always find one in which he can learn the latest and best principles, devices and methods of any trade or profession he may desire to follow. Add to all these the latest German innovation of commercial high schools and colleges of commerce, then wonder, if you can, why German competition is so keen and why German trade and industry are reaching every market the world over. The Germans have discovered that the secret of success in trade and industry depends upon education: not upon the education of the library and cloister, but upon the education of the laboratory, the shop and the modern lecture room.

Contrast with this the condition of England.

In 1870, Great Britain, exclusive of her colonies, did one-quarter of the world's business, and, including her colonies, 35 per cent. In 1895, her share had fallen to 18 per cent., or, including her colonies, to 31 per cent., showing that while she still held the lion's share, that share was steadily diminishing. From another point of view, a similar tendency can be seen. Between 1870 and 1895, British exports increased only 13 per cent., while during the same period the exports of Russia increased 17 per cent., of France 20 per cent., of Germany 42 per cent., and of the United States 110 per cent., showing that England's commercial advancement during this period was relatively the least of all.

American tools and labour-saving devices are rapidly entering British workshops. One firm recently expended 100,000 dollars in new machinery, two-thirds of which was of American make. In other branches of manufacture, the American and Continental engineers have succeeded in introducing into England many articles which the English imagined, but a short time ago, could not be made cheaper or better than in Great Britain, like electrical machinery, locomotives, steel rails, sugar-producing machinery, and even stationary engines, the pride of the British engineering industry. The year 1901 was noteworthy in that the output of steel in Great Britain fell behind that of the United States by 5,000,000 tons and behind that of Germany by more than a million tons. The machine tool trade is also fast becoming Americanised. In agricultural machinery, the United States is outstripping England with giant strides. In gas machinery, Continental orders are seldom

[1] Abridged from a paper on the need of technical education, by Prof. Victor C. Alderson, Dean of the Armour Institute of Technology, read before the Chicago Literary Club, October 20, 1902.

placed in England except for patented apparatus or by gas concerns controlled by British capital. The National Physical Laboratory, the British institution corresponding to the Reichsanstalt of Germany and the U.S. National Bureau of Standards, gets the absurdly small sum of 20,000 dollars per year, while the "beer money" appropriated to technical schools of the second and third rank amounted in 1898–9 to 4,152,000 dollars and in 1899–1900 to 4,380,000 dollars.

That there is "something the matter" with English economics seems evident to an impartial observer. Public opinion is slowly awakening to a realising sense that in some unseen manner England is being fed, clothed, reorganised and educated by foreigners. Prominent Englishmen, whose warnings are sincere, are trying to tell her that decline is at hand unless she adopts a sweeping reform in the whole content of her educational system, so as to bring it into close relationship with present-day necessities.

The Englishman learns slowly; he prefers to use methods formerly successful in spite of the fact that they are inapplicable to-day; he is slow to disturb established tradition and can scarcely be made to believe that any new forces have entered into the struggle for industrial supremacy. The rest of the world is learning the value of technical training in its varied forms as a foundation for industrial success, but the English still cling to their antiquated ideas. England has not kept alive to the requirements of the new scientific age into which we are now being thrust; she has not recognised the close connection that exists between science and industry; she is, as it were, using mediæval methods in modern industrial warfare; by neglecting the technical education of her people, she has failed to train her industrial army. This alone explains at once her own decadence and the advance of Germany and the United States.

The educational status of England is far lower than many suppose. We are pleased to juggle with the names Eton, Rugby, Oxford and Cambridge, but we must remember that these schools are only for the highest social classes and are maintained to educate the English gentleman of rank, not the plain everyday Englishman, and have little or no good influence upon industrial or commercial life. Through their graduates, who influence much of the editorial writing in London, they are seriously impeding the advance of correct ideas by their ultra conservatism and even ignorance of the scientific spirit of the age. The whole trend of an Oxford or Cambridge education is away from the masses. The primary and grammar schools of England are not only weak and inefficient, but are partly under State and partly under religious control; public high schools, as Americans know them, are non-existent; the higher college and university training is mostly classical and out of harmony with modern necessities; technical education, which in Germany and the United States must be preceded by a good high-school course of study, follows in England a weak grammar school education. Outside of her college preparatory schools and her two universities, which reach only an exceedingly small fraction of her people, England provides educational facilities which are utterly inadequate, both in character and extent, to the enormous needs of her people. To a certain extent, the view of Dr. Johnson still prevails that education is "needed solely for the embellishments of life and is useless for ordinary vermin."

The temper of the British mind is against scientific and technical progress. Research work, which is really the guiding star for all human progress, is sadly neglected. New ideas are imported from Germany and the United States; they seem unable to germinate on British soil. London, which was the first city to be lighted by gas, is the last to accept electricity. Germany teaches England electrochemistry and the United States gives her lessons in electric traction. Low-grade technical schools, evening schools and polytechnics she has in abundance; but they train only the imitative, not the creative faculties. England hates the specialist; Germany glories in him. England relies upon the practical man; Germany upon the technically trained man. England exalts the "rule-of-thumb" method; Germany insists upon scientific accuracy. England has no national system of education; Germany has a highly organised, Government-controlled system; England places her technical training next above a weak elementary education; Germany, believing in specialised education, which must be concerted and not premature specialisation, places her technical training after a thorough general education.

The race for industrial supremacy is on; the first three places are undoubtedly held by England, Germany and the United States. In view of the need of economic progress, it is not difficult to see that the outcome of the feeling of unrest which now pervades the educational world will be the enlargement of the sphere of technical education. All the signs of the times point in this direction. The trained technical man is rapidly taking the place of the untrained man. No nation can successfully oppose this world-wide movement. When the philosophers, educators and economists have risen to a full comprehension of the meaning of the present world-wide educational unrest, they will see that the solution of their doubts and anxieties lies in a fuller and more comprehensive development of the sphere of technical education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On Saturday last, Mr. H. Brereton Baker, F.R.S., Balliol College, was elected to the Lees readership in Chemistry, which had become vacant owing to Mr. Vernon Harcourt's resignation. Mr. Baker came up to Balliol as a Brackenbury scholar in 1880, and took a "first" in natural science in 1883. He was a pupil of Prof. Dixon, at that time lecturer in chemistry at Balliol, and he also worked under Mr. Harcourt at Christ Church. On leaving Oxford, Mr. Baker went to Dulwich, where he remained until last May, when he was appointed head-master of the Alleyn's School. His election is naturally very popular, and Oxford will gladly welcome back one of her most distinguished chemists, particularly one who has shown that the duties of a schoolmaster are not incompatible with the carrying on of research.

On Saturday, February 14, a meeting of the resident members of the University who are interested in the teaching of natural science will take place in the examination schools to meet a deputation from the Association of Public School Masters, consisting of Mr. H. B. Baker, of Dulwich, Mr. Hill, of Eton, Mr. Sclater, of Charterhouse, and Mr. Shenstone, of Clifton. The following proposals of the association, respecting entrance scholarship examinations to the universities, will be brought before the meeting:—(1) That the science part of the examination should consist of (*a*) a paper on elementary physics and chemistry for all candidates; (*b*) papers and practical work in not more than four subjects: (i.) physics; (ii.) chemistry; (iii.) botany and zoology; (iv.) geology. Of these subjects, candidates must not offer more than two. (2) That very marked excellence in one of the four advanced subjects should have due weight.

CAMBRIDGE.—Mr. T. Manners-Smith, Downing, and Dr. Marett Tims, King's, have been appointed additional demonstrators of anatomy.

Mr. W. A. Cunnington, Christ's, has been appointed to work at the University table in the Naples Zoological Station.

The Library Syndicate report that the cost of providing suitable accommodation and catalogues for the Acton Library, presented by Mr. John Morley, will amount to more than 730*l*.

Dr. MacAlister, Prof. Woodhead and Dr. Nuttall have been appointed to represent the University at the Brussels Congress of Hygiene and Demography, to be held next September.

The following have respectively been appointed electors to the professorships named:—*Chemistry*, Dr. T. E. Thorpe; *Plumian of Astronomy*, Mr. W. H. M. Christie; *Anatomy*, Dr. T. C. Allbutt; *Botany*, Mr. A. Sedgwick; *Geology*, Dr. S. F. Harmer; *Jackson of Natural Philosophy*, Lord Rayleigh; *Downing of Medicine*, Dr. A. Macalister; *Mineralogy*, Prof. J. J. Thomson; *Zoology*, Dr. D. MacAlister; *Experimental Physics*, Lord Rayleigh; *Mechanism*, Mr. O. Reynolds; *Physiology*, Prof. G. S. Woodhead; *Surgery*, Dr. A. Macalister; *Pathology*, Dr. W. H. Gaskell; *Agriculture*, Dr. W. Somerville.

Sir James Blyth, Bart., has been appointed a member of the Board of Agricultural Studies.

DR. VICTOR LEBEUF, of the University of Montpellier, has been appointed director of the astronomical observatory at Besançon, and Dr. Marcellin Boule to the professorship of palæontology at the Paris Natural History Museum.

THE trustees of the Michigan College of Medicine and Surgery have established, the *British Medical Journal* states, two new chairs in tropical diseases with the object of preparing medical practitioners to deal with those affections in the Philippines and in Cuba. Dr. Robert S. Linn and Dr. V. J. Hooper have been appointed to the chairs.

THE fifth annual dinner of the Association of Old Students of the Central Technical College will be held at the Trocadero Restaurant, Piccadilly Circus, on Friday, February 20, at 7.30 p.m. Prof. W. C. Unwin, F.R.S., president of the Association, will take the chair. Tickets (price 5*s*. 6*d*.) can be obtained on application to the hon. secretary, Dr. E. F. Armstrong, 55 Granville Park, Lewisham, S.E.

IT is stated by the *Times* that the announcements recently made that Rhodes scholars have been elected in South Africa and the United States are inaccurate. The trustees have not yet awarded any scholarships. It is hoped that the scholars from the Cape Colony, Natal and Rhodesia may be elected in time to go into residence in Oxford in October next and also the first students from Germany, who are to be elected by the German Emperor, but the other scholarships will not commence before October, 1904.

THE effort made to clear off the debt of 5000*l*. on Bristol University College has, we learn from the *Times*, been successful. Sir William H. Wills and Sir Frederick Wills, M.P., agreed to give 1000*l*. each, provided that three like donations could be secured. In this the council of the college was not successful, but the offer was allowed to remain open on the understanding that the remaining 3000*l*. should be raised in any sums during the year. On the occasion of the recent University Colston dinner, it was announced that the 5000*l*. had been raised all but 500*l*. In the course of the evening, one of the guests gave 250*l*., and since then 700*l*. has been received, the total of 5500*l*. now reached including a contribution from the Bishop of the diocese, who presided at the dinner.

THE Government of the United Provinces is, the *Pioneer Mail* understands, considering the possibility of establishing a teaching university at Allahabad. The evidence given before the recent Universities Commission showed that the higher learning is almost entirely neglected by the Indian Universities, all the energies of their professors being taken up with pass work for the intermediate and B.A. examinations. The scheme which is being considered by the Local Government is that the Muir Central College should be strengthened and devoted to the higher branches of learning. The intermediate classes would be given up, and this work would be undertaken by a new college to be created for the purpose in Allahabad with its own principal and its own professors. Several new chairs would be added to the present college, and it would thus be able to devote its time to scholarship in the sense understood in Europe and to advanced work in science. In a recent speech, the Agha Khan, president of the Mohammedan educational conference, suggested that ten million rupees should be raised by voluntary subscription among the Mohammedan community to convert the Mohammedan Anglo-Oriental College at Aligarh into a university. It seems clear from such facts as these that educational requirements are receiving great attention in India.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, January 21.—Prof. Emerson Reynolds, F.R.S., in the chair.—The following papers were communicated:—Researches on silicon compounds. Part viii. Interactions of silicophenylamide with thiocarbimides, by Prof. Emerson **Reynolds**. Silicophenylamide readily combines with one or two molecules of the thiocarbimides to form crystalline compounds, which dissociate into their generators at 100° C.; it also reacts with thiocarbimides when heated in sealed tubes, with the formation of silicodiphenylimide and a disubstituted thiocarbamide.—On the relation between the absorption spectra and the chemical structure of corydaline, berberine and other alkaloids, by Drs. **Dobbie** and **Lauder**. It is shown that corydaline and tetrahydroberberine, which are known to possess similar constitutions, give absorption spectra which differ in general absorption, but show no specific absorption differences. This is found to be the case generally for related alkaloids, and the authors suggest that such observations may occasionally be useful in deciding between possible formulæ for an alkaloid.—Absorption spectra of laudanine and laudanosine in relation to their chemical constitution, by Drs. **Dobbie** and **Lauder**. An application of the results of the foregoing paper to these two alkaloids, which are shown to belong probably to the reduced berberine group.—Phenocycloheptene, by Dr. **Kipping** and Mr. **Hunter**. A description of the properties of this hydrocarbon.—The influence of molybdenum and tungsten trioxides on the specific rotations of *l*-lactic acid and potassium *l*-lactate, by Dr. **Henderson** and Mr. **Prentice**. These oxides increase the specific rotations of *l*-lactic acid and of its potassium salt, probably as the result of the formation of salts of the *tartar emetic* type.—Estimation of ethyl alcohol in essences and medicinal preparations, by Dr. T. E. **Thorpe** and Mr. **Holmes**. The mixture is diluted with water, saturated with sodium chloride and shaken out with light petroleum to remove volatile substances other than alcohol; the latter remaining in the residue is estimated in the usual manner.—Carbon monoxide as a product of combustion of the Bunsen burner, by Dr. **Thorpe**. A laboratory burner consuming 6 cubic feet of coal gas per hour under 0.05 inch pressure evolves 0.022 cubic foot of carbon monoxide when burnt under a sand bath at such a height that the inner cone just impinges on the metal of the bath.—The following papers are descriptive of the compounds mentioned, and are not of general interest:—Derivatives of β-resorcylic acid and of protocatechuic acid, by Dr. W. H. **Perkin**, jun., and Mr. **Schiess**.—Synthesis of *N*-ethyl-, *N*-methyl- and *N*-benzyl-benziminoethers, by Dr. **Lander**.—The condensation of phenyl ethyl ketone with benzalacetophenone and of acetophenone with benzalpropiophenone, by Dr. **Abell**.—Synthesis of 1:3:5 triphenyl-2:4-dimethyl*cyclo*pentane and of 1:3:5-triphenyl-2-methyl*cyclo*pentane, by Dr. **Abell**.—Formation of carbazoles by the interaction of phenols, in the orthoketonic form, with arylhydrazines, by Prof. **Japp** and Mr. **Maitland**. (1) Dimorphism of α-methylanhydracetonebenzil. (2) The oxidation products of the methyl homologues of anhydracetonebenzil, by Prof. **Japp** and Mr. **Michie**. Action of hypobromites on amides, by Dr. **Lapworth** and Mr. **Nicholls**.—Derivatives of menthyl cyanoacetate, by Messrs. **Bowack** and **Lapworth**.—The influence of nitro-groups on the reactivity of halogen derivatives of benzene, by Dr. **Lapworth**. A restatement of the view that the reactivity of the halogens in *ortho*- and *para*-halogenated nitrobenzenes is due to the assumption of the elements of a molecule of water by the nitro-group, with subsequent intramolecular changes, leading to the production of a tautomeric form of a nitrophenol with the loss of a molecule of a haloid acid.

EDINBURGH.

Geological Society, February 5.—Dr. J. Horne presided.—Mrs. Dr. Ogilvie **Gordon** gave a demonstration of some of the results obtained by her geological survey of the Fassa district in South Tyrol, made in 1900–1901. The lecture, which was entitled "The Fassa-Monzoni District or Simultaneous Duplex Crust Movements," was illustrated by Mrs. Gordon's lantern views, geological maps and sections, rock specimens and mineralogical slides. In describing the succession of Triassic strata, Mrs. Gordon pointed out two distinct advances made by her work: (1) She had discovered the presence of Wengen-Cassian Marls with characteristic fossils in the midst of the Middle Triassic Limestones, whereas hitherto these fossiliferous strata had been reported to be absent in Fassa. The Wengen series comprise bedded tuffs and lavas, tufaceous grits, shales, and limestones like those in Gröden and Enneberg; the Cassian strata are chiefly marls and marly limestones. (2) She had determined the presence of a definite band of fossiliferous marls and Crinoidal and Oolitic Limestones between the Lower and Middle Trias, as a constant member in all undisturbed sections. Hitherto these limestones had been described as a rarely present facies of the lower horizons of Middle Triassic Limestones. The fossils collected in them by Mrs. Gordon were examined by Dr. Broili, Munich Museum, and identified by him as Upper Werfen (Lower Trias) or closely allied types. The establishment of this definite passage-zone between Lower and Middle Trias was an important addition to the geology

of South Tyrol. Further, it corresponded to the horizon of the "Reichenhall Limestone" and the "Myophoria Beds" in North Tyrol, and probably also to the well-known "Röth" horizon in the North German Trias. Throughout the Tertiary crust-movements in the Alps, this passage-zone had been the *great crush-zone* of the district. It occurred in Fassa below a massive development of calcareous rocks, and above an almost equal thickness of mixed deposits; it was, therefore, a well-marked "critical" zone, within the earth's crust, interleaved between rock material presenting strongly contrasted physical characters. One of the *general* results of the lecturer's detailed survey had been to prove that porphyrite sills and sheets had been intruded in Fassa into the local fault lines and planes of crust deformation which developed during Middle and Late Tertiary Alpine movements. After indicating on her geological map the complete sequence of the igneous rocks which she had proved at Monzoni (see *Geological Magazine*, July, 1902), Mrs. Gordon proceeded to describe her results regarding cross-fold formation. Several deformational movements had affected this district. In the first place, undulations directed east and west had formed a steep southern face and a long northern slope, the width of an undulation being about four and a half miles. These had been deformed by *oblique* cross-folds, which developed along two directions, E.N.E., W.S.W. and W.N.W.-E.S.E., the E.N.E.-W.S.W. direction being the principal axis of deformation. During these "Asta" movements the steep south faces of the original plications were overthrust towards S.S.E., or locally towards S.S.W., and the first inrush of molten rock occurred into zones of crust-attenuation and fracture. Still later another duplex deformational system (the Judicarian) was superinduced upon the earlier; the principal axis was N.N.E.-S.S.W. in direction, but the leading N.N.E.-S.S.W. faults were cut by N.N.W.-S.S.E. companion faults. Horizontal differential movements had occurred, and local thrusts and shear slips took place again, fragmenting the previous thrust-masses and igneous intrusions. Mrs. Gordon showed by reference to her map that the most intense effects of crust-deformation had been coeval with this advanced stage in the superposition of duplex deformational systems upon the original and fundamental east-west undulations. The larger intrusions of augite porphyrite had passed into fault-planes, which were associated with the advanced stages of movement. A subsequent epoch of crust-adjustment and surface-erosion had ensued, characterised by local subsidences taking place preeminently along the previous crust-fractures. Local crumplings had then occurred, chiefly around large masses of igneous rock or the larger deformation fragments of Triassic Limestone. Small igneous intercalations of highly differentiated rock material accompanied these inthrows. Mrs. Gordon's interpretation of this remarkable series of cross-movements was based upon the principle of the simultaneous action of paired resultant strains acting along N.E.-S.W. and N.W.-S.E. directions, the precise directive angle varying in proportion as the east-west or the north-south stresses due to crust-compression were the more powerful, and also in accordance with particular local modifications of the regional strains. The address gave rise to prolonged discussion, in which Mr. Cadell, Mr. Clough, Mr. Cunningham-Craig, Mr. Bailey and the chairman took part.

PARIS.

Academy of Sciences, February 2.—M. Albert Gaudry in the chair.—Remarks by M. Ph. van **Tieghem** on a memoir "Sur les Ochnacées."—Contribution to the history of fossil man, by M. Albert **Gaudry.** Most of the fossil remains of man date from the Glacial epoch, contemporary with the reindeer and mammoth. But there are a few fossil specimens which appear to be earlier than the Glacial epoch, and to date from a warmer period of the Quaternary. It has been generally concluded that, as a result of the extension of the Scandinavian glaciers, the existing animals, including man, were driven south. The question of the origin of the men of the warmer period is more difficult. From a comparison of the dentition of a skull discovered at Mentone, and dating from the latter period, with that of the fossils of the Glacial period and of existing races, the conclusion is drawn that these men were indigenous to the southern regions, but as these results are arrived at from the examination of a single specimen, further confirmation of this view is necessary.—On the heart of tuberculous subjects, by MM. Ch. **Bouchard** and **Balthazard.** A preliminary comparison of the hearts of healthy and tuberculous subjects appeared to show that in tuberculous males the heart is smaller than in healthy males, whilst in tuberculous females the heart is very nearly normal. A more detailed study of these subjects showed, however, the influence of the stage of the disease and also the effect of predisposition. The opinion which has often been expressed, but never clearly demonstrated, that smallness of the heart predisposes to tuberculosis is now confirmed by these observations.—On the absorption of light in symmetrical crystalline bodies and in certain disymmetrical media, such as substances naturally isotropic, solid or fluid, affected by magnetism and submitted to its action, by M. J. **Boussinesq.**—On the latest comet, by M. **Perrotin.** The Giacobini comet is not identical with the Tempel-Swift comet, and is probably new.—Approximate algebraic expressions for transcendental, logarithmic and exponential functions, by M. J. A. **Normand.**—On the viscosity in a vitreous medium, by M. P. **Duhem.**—On the polarisation of the X-rays, by M. R. **Blondlot.** All attempts made hitherto to produce polarisation of the X-rays have been without positive results, and the possibility of their being actually polarised on emission from the tube seemed worthy of examination. The use of a small electric spark, similar to that already used by the author in his researches on the velocity of propagation of the X-rays, as an analyser, showed that this view is in accordance with the facts observed; a bundle of X-rays has the same asymmetry as a bundle of polarised light rays. Quartz and sugar turn the plane of polarisation of the X-rays in the same sense as that of light, rotations up to 40° having been observed. The secondary X-rays, or δ-rays, are equally polarised; active substances turn the plane of polarisation in the contrary sense to that of light. The author regards it as extremely probable that magnetic rotation exists both for the X-rays and the δ-rays, and further experiments upon this are in progress.—The perpetual secretary informed the Academy of the death of M. Reboul, correspondent in the section of chemistry.—M. Léon Labbé was elected a free academician in the place of the late M. Damour.—Observations of the comet 1903 *a*, made with the 35 cm. equatorial of the Observatory of Lyons, by MM. J. **Guillaume** and G. Le **Cadet.**—Provisional elements of the new Giacobini comet (1903 *a*), by M. G. **Fayet.**—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the fourth quarter of 1902, by M. J. **Guillaume.** The results are summarised in three tables, giving the number of sun-spots, their distribution in latitude and the distribution of the faculæ in latitude.—On a rectilineal band of Jupiter, oblique abnormally to the equator, observed in December, 1902, and January, 1903, by M. **Amann.**—On groups of substitutions, by M. G. A. **Miller.**—On active couples of permutations, by M. Désiré **André.**—On slipping in fluids, by M. **Hadamard.**—On the reciprocal influence of two neighbouring oscillators: the character of the discontinuities, by M. Marcel **Brillouin.**—New researches on the expansion of nickel steel, by M. C. E. **Guillaume** (p. 352).—On the esterification of mannite by phosphoric acid, by M. P. **Carré.**—On the signification of experiments made in balloons on the respiratory exchanges, by M. J. **Tissot.** A criticism of some results published by Schrœtter and Zuntz. The author sees no reason to doubt the accuracy of the experimental results previously published by him, and summarises the conclusions to be arrived at from these experiments.—Contribution to the morphology of the ligaments accessory to the temporomaxillary articulation by M. J. **Chaine.**—On the presence of ergastoplasmic formations in the follicular epithelium of birds, by Mlle. Marie **Loyez.**—Observations on the genesis of giant cells, by M. V. **Babes.** Besides simple cell division, budding occupies an important place in the growth of tissues, and a large proportion of giant cells are only modifications of these buds. This view is applied to the consideration of the growth of the placenta, giant tuberculous cell myxo-sarcoma, and other cases.—The ratio of the weight of the liver to the total weight of the animal, by M. E. **Maurel.** Except during

the earliest period of life, for the same animal species of different ages, the ratio of the weight of the liver to the surface remains constant. This constancy of ratio exists also for different varieties of the same species, although, as in the case of the dog, there may be considerable differences of volume.—Observations on *Monas vulgaris*, by M. P. A. **Dangeard.**—Mendel's law and the constant characters of hybrids, by M. Hugo **de Vries.**—On the comparative structure of the point of junction in grafted plants, by M. Lucien **Daniel.** A study of the point of union of the graft showed that even when the operation is made between plants as like as possible, and by the same process, the structure is essentially variable and is dependent on the mode of cicatrisation. As a result of these differences of structure, the conduction of the sap is modified more or less in each graft. The great differences observed explain the contradictory results obtained by different observers.—On vegetation in atmospheres rich in carbon dioxide, by M. E. **Demoussy.** It was shown that the gases given off by earth and manure are favourable to vegetation, and further experiments proved that this result was due to the influence of carbon dioxide alone. The conclusion is drawn that plants may profit to a very high degree from the presence of a small excess of carbonic acid in the atmosphere.—On the granitic rocks of the *massif* of Beni-Toufout, between El-Milia and Collo, Algeria, by M. Pierre **Termier.**—The existence of the Upper Jurassic and the infra-Cretaceous in the Island of Crete, by M. L. **Cayeux.**—On the quantities of phosphorus contained in flour, by M **Balland.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 12.

ROYAL SOCIETY, at 4.30.—On the Decline of the Injury Current in Mammalian Nerve, and its Modification by Changes of Temperature. Preliminary communication: Miss S. C. M. Sowton and J. S. Macdonald.—On the Negative Variation in the Nerves of Warm-Blooded Animals: Dr. N. H. Alcock.—On the Optical Activity of Hæmoglobin and Globin: Prof. A. Gamgee, F.R.S., and A. Croft Hill.—On the Nucleo-Proteids of the Pancreas, Thymus and Suprarenal Gland, with especial reference to their Optical Activity: Prof. A. Gamgee, F.R.S., and Prof. W. Jones.—Studies in the Morphology of Spore-producing Members. No. V. General Comparisons and Conclusion: Prof. F. O. Bower, F.R.S.—Primitive Knot and Early Gastrulation Cavity coexisting with Independent Primitive Streak in Ornithorhynchus: Prof. J. T. Wilson and J. P. Hill.—The Brain of the Archæoceti: Prof. Elliot Smith.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—If the adjourned discussion on the Metric System is concluded at the Meeting on February 5, the adjourned discussion of Messrs. Scott and Esson's paper will be taken.

MATHEMATICAL SOCIETY, at 5.30.—Note on a Point in a Recent Paper by Prof. D. Hilbert: E. T. Dixon.—Some Properties of Binodal Quartics: H. Hilton.—The Field of Force due to a Moving Electron: Prof. A. W. Conway.—On Birational Transformations of the Type of Inversion: Prof. W. Burnside.

FRIDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 9.—Health Dangers in Food: Prof. Sheridan Delépine.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 5.—Address by the President elect.

MALACOLOGICAL SOCIETY, at 8.—Annual General Meeting.—Address on the Molluscan Larva in Classification: Prof. G. B. Howes, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of Tunnels in the London Clay: H. A. Bartlett.

MONDAY, FEBRUARY 16.

VICTORIA INSTITUTE, at 4.30.—The Cheesewring, Cornwall, and its Teachings: Prof. Edward Hull, F.R.S.

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

TUESDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 5.—The Physiology of Digestion: Prof. Allan Macfadyen.

ZOOLOGICAL SOCIETY, at 8.30.—On some new Species of Spiders belonging to the Families Pisauridæ and Senoculidæ: F. Pickard-Cambridge.—On the Marine Fauna of Zanzibar and British East Africa, from Collections made by the Author in 1901-2: Cyril Crossland.—On the Habits of the Hoolock: G. Candler.

SOCIETY OF ARTS, at 8.—Heraldry in Decoration: George W. Eve.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*:—The Manufacture and Efficiency of Armour-piercing Projectiles: D. Carnegie.—*Paper to be read, time permitting*:—Mechanical Handling of Material: G. F. Zimmer.

WEDNESDAY, FEBRUARY 18.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Demonstration on the Photo-micrography of Opaque Objects as Applied to the Delineation of the Minute Structure of Chalk Fossils: Arthur W. Rowe.

SOCIETY OF ARTS, at 8.—Three-Colour Printing: Harvey Dalziel.

CHEMICAL SOCIETY, at 5.30.—(1) The Molecular Rearrangement of N-substituted Imino-Ethers; (2) The Nature and Probable Mechanism of Metal Replacement in Tautomeric Compounds: G. D. Lander.—The Chlorine Derivatives of Pyridine. Part VIII. The Interaction of 2:3:4:5-Tetrachlorpyridine with Ethyl Sodiomalonate: W. J. Sell and F. W. Dootson.—The Biological Method for Resolving Inactive Acids into their Optically Active Components: A. McKenzie and A. Harden.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Report on the Phenological Observations for 1902: E. Mawley.

THURSDAY, FEBRUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Formation of Definite Figures by the Deposition of Dust: Dr. W. J. Russell, F.R.S.—Mathematical Contributions to the Theory of Evolution. On Homotyposis in Homologous but Differentiated Organs: Prof. Karl Pearson, F.R.S.—The Evaporation of Water in a Current of Air: Dr. E. P. Perman.—On the Determination of Specific Heats, especially at Low Temperatures: H. E. Schmitz.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

LINNEAN SOCIETY, at 8.—Electric Pulsation in *Desmodium gyrans*: Prof. J. C. Bose.—*Cerataphis Lataniae*, a remarkable Aphid: Alice L. Embleton.—Specialisation of Parasitism in the Erysiphaceæ: S. E. Salmon.

FRIDAY, FEBRUARY 20.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

ROYAL INSTITUTION, at 9.—The Measurement of Energy: Principal E. H. Griffiths.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Hydraulic Experiments on a Plunger Pump: Prof. John Goodman.—Experiments on the Efficiency of Centrifugal Pumps: Thomas E. Stanton.

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THURSDAY, FEBRUARY 19, 1903.

ELECTRIC RADIATION FROM WIRES.

Electric Waves. Being an Adams Prize Essay in the University of Cambridge. By H. M. Macdonald, M.A., F.R.S., Fellow of Clare College. Pp. xiii+200. (Cambridge: University Press, 1902.) Price 10*s.*

THE essay under review consists essentially of two parts. In one of them the author aims at a re-statement of electrodynamic theory in a manner which will avoid what he considers to be the difficulties of the existing dynamical expositions. The other part contains new developments relating to the mode of propagation of electric radiation, its emission and absorption by resonating wire circuits, and the dynamical laws of its diffraction by obstacles.

In illustration of the power of the mathematical analysis that is developed in the latter part, it may be mentioned that the general dynamical problem of diffraction at the edge of a perfectly conducting (*i.e.* totally reflecting) prism is solved in a few pages at the end of the book (Appendix D) by a method which admits of extension to any transparent or metallic prism the optical constants of which are known. The only case of diffraction in which a rigorous dynamical solution had been previously obtained is that of the straight edge of a perfectly conducting plate, which is the special case of a prism of vanishing angle; this had been reached through intricate analysis by Poincaré and by Sommerfeld, and the result is now often reproduced as a new departure in mathematical physics applied to problems in theoretical optics. The very elegant treatment in terms of Bessel functions that is brought to bear by Mr. Macdonald will remind readers of a previous successful application of essentially the same analysis, namely to the verification of Mr. W. D. Niven's beautiful functional solution of the problem of electric distribution on the general type of conductor bounded by two intersecting spheres, which was published some years ago in the *Proceedings* of the Mathematical Society. Features of much interest are bound to arise in the theoretical character of the diffraction at the edge of a transparent or metallic prism of known index; it is to be hoped that the author will not be deterred by some inevitable complexity of computation from following out in detail this natural extension of his results.

When disruptive electric disturbances take place in a material system, their energy is, in the ordinary course, dissipated by electric radiation into space, in so far as it is not degraded into heat by resistance. That any other state of affairs could exist has not been hitherto contemplated, though it has been known by experience that an electric vibrating system like the ring resonator of Hertz could go on oscillating for very many thousands of periods without much loss. The author claims that it is possible theoretically to have electric vibrating systems absolutely permanent, which would last for ever so far as radiation is concerned; that if electric waves are introduced into a nearly complete wire circuit, and if the ends are then connected so as to make the circuit a complete ring, a portion of the wave-motion will settle down into a steady state in the circuit and run round and round for ever, assuming, of course, that the circuit is perfectly conducting; that as such waves can only enter through the ends, so the only way of dissipating them is by cutting the circuit and allowing them to escape from the ends. This, even if it is not valid for thick anchor rings, is certainly practically correct for thin wires; and such systems in which electric oscillations are going on thus radiate mainly from the ends or points of the wires. The nature of the beam of radiation which issues from the end of a straight wire is here investigated theoretically, the form obtained for the wave-fronts around the end being shown to be in close accord with the observations of Birkeland and Sarasin. Fortified with this theoretical analysis, we can form a more vivid and confident idea of how exposed metallic points like those of lightning conductors may gather up stray radiations in the surrounding space, which may then be passed down around a system of properly attuned loops forming nearly closed circuits in the lower part of the wire, in each of which a selected period can be intensified by resonance and tapped off through a relay system into an appropriate recorder; and we can even imagine that the direction from which an incident train of disturbances comes may be estimated from the orientation of the plane of the resonating loop which responds to it most intensely.

The whole theoretical discussion is founded on, and in turn elucidates, an extension of the ancient electric dogma of the power of points into the new field of electric radiation. Closed electric circuits can be placed in relation of radiation and absorption with the surrounding æther, after the manner of radiating atoms in temperature equilibrium, by narrow breaks or attached spikes. The subject is far from being exhausted; for example, the more complex and probably far more difficult problem suggests itself to compare the radiation that must escape from a sharp bend in the wire carrying the waves with the radiation issuing from its open end. From the standpoint of present interests, the theoretical elucidation of the circumstances on which depend the free periods of resonators of the Hertz pattern formed of simple wire rings with or without knobs at the ends, to which close attention is also devoted in the book, is hardly as important as this other related question of the theoretical conditions governing the emission and absorption of radiation from wire circuits and networks.

The periods of free electric surging in the dielectric sheets of various forms of condensers are also discussed; the correction for the open edge of a flat condenser is determined, expressed in the form that by adding a slip of certain breadth to the plates all round the edge the electric field between them may be taken as uniform right up to it. The result comes, of course, from application of the general principles of the mode of analysis applied in acoustics by Helmholtz in 1859 to the correction for the open ends of organ pipes.

As developed by our author, the key to the discussion of the oscillations and their free periods, in open wire circuits, lies in the determination of the radiation from the end part of a straight wire when standing electric

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waves are surging along its surface. This provides a knowledge of the ratio in which the distance of the open end from the nearest node falls short of half a wave; and, the other successive nodes being practically equidistant, it thus affords a knowledge of the free periods in terms of the length of the wire. Finite curvature of the wire does not sensibly affect things; this was elucidated very clearly by Pocklington in 1897,[1] and his analytical device for replacing the electrification and electric flow on the wire by a series of changing electric doublets situated along it, the fields of disturbance of which are simply expressible, is here largely employed. Consider, in fact, a system of doublets of moment σ (in the magnetic sense) per unit length distributed along the length s of the wire; they are equivalent to a current of intensity $d\sigma/dt$, a charge of line-density $-d\sigma/dx$, and two point-charges $-\sigma_1$ and $+\sigma_2$ at the ends; as the true current vanishes at the ends, σ must be constant there, and so will vanish too. This kind of theory leads very directly, in § 67, to the character of the forced oscillation on the wire that is established by an impressed magnetic field in the surrounding region, which is symmetrical and therefore ranged in circles around the wire as axis. Each infinitesimal ring of impressed alternating magnetic force is propagated out directly into wider rings until it meets the point of the wire under consideration, but *in addition* it travels to the open end of the wire and thence down its ength, the signs being such that the two parts cancel at the end; the amplitudes of these two interfering systems of rays of magnetic force are not attenuated with increase of the distance traversed, because each point of the wire is equidistant from all elements of the source. It is their interference that constitutes the standing waves on the wire. We have here rings of magnetic disturbance radiated from the outside sources, converging on the wire through its open end, and travelling down it; it would appear that the author's restriction to symmetry may largely be dispensed with. The conditions are now reversed, and a system of standing oscillations on the wire pouring out radiation into space is contemplated; that occurs only through open ends, the oscillatory surging on the perfectly conducting wire elsewhere being capable of adjusting itself locally, like waves on a musical cord, without having to constrain any radiation. If we know the distribution of the radiation from the open end of a straight wire, over the infinite sphere, we can, by reversal of the motions and treating the infinite spherical surface as a region of sources of disturbance, deduce by the previous analysis the positions of the nodes on the wire. In applying this method, the author considers (§ 78), for reasons not obvious, that an open end radiates uniformly over the hemisphere in front of it.[2] In the discussion of the Hertzian wire resonator which follows, the two contiguous ends are taken to constitute a Hertzian oscillating doublet, and this determines the required distribution of radiation at infinite distance; the reversed radiation is supposed to affect the two ends independently. One feels more confidence here than in the previous case of a single end; and the results are, in fact, in very close agreement with experimental measurements by Sarasin and de la Rive. The modification arising from arming the ends with small balls or plates is also gone into.

The author's verification of the known form of the wave-fronts near the open end of a wire, namely confocal paraboloids with focus at that end, also comes from the reversed motion as above. It appears that this result holds whatever be the distribution of the radiation over the infinite sphere, the magnetic force around the end being of the form $A \tan\frac{1}{2}\theta$. The author adverts to the transverse wave-fronts travelling along the wire towards the end and finally bending round near the end into paraboloids as it is approached; the wave-front may be considered as detained on the wire because the magnetic force is cyclic around the wire and could not be cyclic if the front escaped into free space. In fact, the value of the magnetic force above given obviously satisfies this necessary condition, its circulation $2\pi r \sin\theta . A \tan\frac{1}{2}\theta$ being equal to $4\pi A r$ along the wire and equal to zero along its prolongation; the current in the wire near the end is thus Ar. We have, therefore, only to show that the characteristic equation of a magnetic field disposed in circles around the wire is satisfied; and this is so, for by the Amperean relation it leads to a longitudinal component Z of electric force proportional to r^{-1}, which is of the right form, being near the end practically $e^{\iota\kappa r}/r$, which satisfies the equation $\nabla^2 Z + \kappa^2 Z = 0$. The transverse component of the electric force s similarly found to be proportional to $-r^{-1}\tan\frac{1}{2}\theta$ thus the resultant force is in the direction bisecting the angle between r and the direction of the wire produced, and is therefore tangential to parabolic wave-fronts as above stated, being wholly transverse close to the wire. There is some temptation to imagine the wings of the parabolic part as advancing towards each other and forming a narrow neck which is finally nipped through, the main part of the front then going off as a plane sheet of radiation, while the other part retreats back into the wire and gives rise to a reflected wave, somewhat in the manner described by Hertz ("Electric Waves," p. 144) for the case of an oscillating doublet.[1] For free oscillations on a wire with two ends, the radiation is, however, sideways.

The circumstance that the general features of some of the author's conclusions can be traced by simple reasoning, as he himself indicates, does not, of course, detract from their value or novelty; it rather tends to confirm the validity of the powerful mathematical analysis to the results of which they are a first approximation, and should stimulate similar inquiry as regards the other part of his results. That this type of analysis is yet destined to point the way into the heart of other important problems in mathematical physics there can be no doubt; now that spherical and ellipsoidal forms have received such

[1] *Proc.* Camb. Phil. Soc. In this powerful paper, the radiation from a complete circular wire comes in evidence, in a second-order approximation, through a very slight damping of the free oscillations. On the view above described, there should be no such effect; yet, on the other hand, the electricities can be separated to the two sides of the ring by an electric field, and should surge back in vibratory manner when released.

[2] It appears that the assumption of a considerably different law would not much affect the result.

[1] Mr. Macdonald infoims me that tbis view is supported by the graph of his second approximation in § 77.

abundant attention, it is much to have a method that can deal in comparative simplicity with edges and prisms and cones.

The evidence is closing in more and more rigorously that the medium which transmits electrical and radiant effects must either completely accompany matter in bulk in its movements or else be entirely independent of such movements. If we adopt the latter hypothesis, to which theoretical considerations strongly point, and we still consider the æther to be something possessing translatory inertia, the nature of its kinetic energy will be entirely at our disposal as regards interpretation.

The author's order of exposition, in the theoretical chapters of this book, first develops the equations for the free æther, in terms of a vector potential; these are naturally purely vibrational; then the disturbance of electricity, which is really the exciting source of the phenomena, is introduced by adding the electric flux $-4\pi(u, v, w)$ to the expression $c^{-2}\frac{d^2}{dt^2}(F, G, H)$, which by these equations of propagation is equated to $\nabla^2(F, G, H)$. In other words, the elements of current are each of them introduced as a simple intrinsic pole of the vector potential, which in other respects obeys the purely vibrational equations for the æther of empty space. These equations, as solved by the Poisson analysis suitable for such cases, represent disturbances travelling out from the poles in the known manner of simple compact propagation, at any rate in all cases where the phenomena are periodic. The electric flux thus introduced is here named the convection current, presumably because it is afterwards going to be considered as arising solely from the motion of electric charges or ions; in the analysis of Appendix C it is the motion of a volume density. The significant remark now follows that

"the assumption is implicitly involved that Maxwell's æthereal displacement current is independent of the motion of the æther, if there is such a motion."

Does this mean that it belongs to the æther, but yet is disconnected from it so that it is left behind if the æther moves on? One is tempted to amend the last phrase and make it read, "therefore there is no such motion."

However this may be, practically it comes to the same thing; in the next chapter, the æthereal part of the total current is taken not to depend on the motion of the æther, but the convection current does depend on the motion of the matter. This leads, as is known, to Fresnel's formula for velocity of optical propagation in moving material media, and to the law of astronomical aberration of light; and the author's *dictum*, above quoted, has already *postulated* that it is not to affect the phenomena whether the æther moves or not.

The reluctance shown by the author to considering the æther as stationary in space is based mainly, it appears, on the ground that a field of magnetic force must be concerned with motion in the æther, so that if that medium were otherwise at rest, waves of radiation would be convected by a magnetic field. This is known not to be the case to any recognisable extent; and it is here explained that the magnetic motions are only a part of the disturbance, there being other latent motions in the æther which may exactly compensate. But, on the other hand, the objection is not essential; for magnetic energy may not be energy of simple translation, while if it is so, the velocity need not be of detectable magnitude provided the inertia is sufficiently great. And in the latter case these other latent motions would surely be themselves magnetic. This consideration points to retaining the most precise and directly presentable scheme, until it is definitely proved to be too narrow.

In the body of the book, the mathematical analysis is developed from the foundation of the circuital laws of Ampère and Faraday, as translated into simple analytical form, and rendered self-consistent by the introduction of displacement currents, originally by Maxwell. In Appendix C, these relations are fitted into a purely dynamical frame. They are derived from potential and kinetic energy functions

$$T=\tfrac{1}{2}\iiint\left(F\frac{df}{dt}+G\frac{dg}{dt}+H\frac{dh}{dt}\right)dx\,dy\,dz,$$

$$W=\tfrac{1}{2}\iiint(Xf+Yg+Zh)dx\,dy\,dz;$$

but the other Maxwellian expression, more like ordinary kinetic energy,

$$T=\frac{1}{8\pi}\iiint(\alpha^2+\beta^2+\gamma^2)dx\,dy\,dz,$$

is considered to be unwarranted. This must mean that the kinetic energy is distributed in the medium according to the first form of integral, and that the second, though it gives the right total amount throughout all space, does not express its correct distribution in space. This is a question as to matter of fact. Not to press the point that the element of energy given by it is not essentially positive, the first specification might be thought to imply that (F, G, H) can be expressed in terms of the local conditions alone; but the only formula for this vector that is given is a volume integral depending on the state of the whole electric field. One result of the change is, of course, that the Poynting vector for the flux of energy must be modified, so that near the vibrator the paths of rays would be altered; when the waves become plane it does not matter.

If we turn to the mathematically analogous (but physically different) hydrodynamic theory by way of illustration, the kinetic energy of a fluid containing vortex lines can be expressed in terms of the vorticity by a cognate integral involving the vortex distribution alone, and the behaviour of the vortexes might be deduced from it, abstraction being made altogether of the fluid in which they exist. So the phenomena of the electric currents would be developed with abstraction altogether of the æther in which they subsist; except that, unfortunately, when the field is not steady, all the æther has to be filled with fictitious æthereal current which is not electric flux at all, *or else* all effects of true electric flux have to be considered as propagated in time. This is, in fact, the course of the actual historical development of the theoretical electrodynamics of ordinary steady

electric currents in the hands of Ampère and his successors; no mention need be made of the æther until electric radiation begins to play a sensible part, either in the establishment of the field or in the draining off of its energy, or until motion of the electric charges is contemplated. In the latter case, it would appear that we have either to take the æther to be at rest or to say with our author that it behaves as if it were so.

The analogy has here been drawn (which Mr. Macdonald doubtless would not allow) between the analysis of the interactions of electric currents in an æther which is intangible and that of vortical smoke-rings in an atmosphere which is invisible. In each case, one would try to avoid assuming unnecessary properties of the medium. And it is only fair to admit that the properties of electric currents have actually been discovered in this way, while without discussing the fluid we should hardly have made much progress with the more fugitive vortexes.

The process of arriving at wider and wider points of view by successive stages of generalisation from an initial hypothesis is a familiar and fruitful one in theoretical physics; though in these latter times the logical and philosophical merits of the converse process of discarding from our knowledge all colorable images or analogies, in favour of bare mathematical expression of the relations of the unknown quantities which are symbols for entities on which we do not wish to dogmatise at all—of which we, in fact, know intrinsically no more than we do about the most common objects around us—has also been amply enforced. Yet in successful instances of this latter procedure, the retort seems open that the hypothesis or analogy has not been dispensed with until it has effectively disclosed of what type the said relations were to be. It very likely arises from want of familiarity with Mr. Macdonald's point of view that a doubt suggests itself as to whether we have not here a case, if not of kicking away the ladder before the passenger has arrived at the top, at any rate of removing the supporting framework before the ties and struts of the permanent structure have become entirely consolidated.

Much in these remarks has assumed a critical form, because after pointing out the excellences that can be enjoyed by consulting the work itself, it would appear that a reviewer could do best service by discussing the matters that are not so clear. Other more detailed topics might be specified which require further consideration. For instance, students of the modern subject of the relation of radiation to temperature would perhaps be puzzled by § 82, which professes to give a new proof of the Stefan-Boltzmann law; the transformation of linear scale of the system æther *plus* matter, there employed, is a very tempting one, but, unfortunately, the free periods do not seem to correspond. It may be put forward as a reasonable generalisation, subject to only a few striking exceptions, that a book which can be acclaimed as free of discrepancies or obscurities is also to a large extent free of new contributions to knowledge. In the present case, the obvious advances are so important that close attention to the work throughout its whole range cannot safely be neglected.

J. LARMOR.

A STUDY IN ALPINE GEOLOGY.

Das Sonnwendgebirge im Unterinnthal. Ein Typus Alpinen Gebirgsbaues. By Dr Franz Wähner. First part. Pp. xii + 350; with 96 illustrations in the text, 19 plates and map. (Leipzig and Vienna: F. Deuticke, 1903.) Price 35 marks.

OF all the labour that has been expended on the fascinating problems of Alpine geology, none, perhaps, has been more fortunate in the manner of its presentation than the work under consideration. A lucid style, fine large type and a wealth of illustration contribute to the enjoyment of an interesting thesis. The weight and bulk of the volume, however, constitute a drawback.

The limited area dealt with by the author comprises the Haiderjoch, Rosan and the Sonnwendjoch; and the formations range from the Triassic Werfen beds to the Upper Jurassic Aptychenkalk; but it is with the rocks about the middle of this series that he is mainly concerned. These are classified in the following, descending, order:—Hornsteinkalk (upper Jura), Hornstein-Breccie, Radiolariengesteine, Rother Liaskalk [Weisser Riffkalk, Ober-rhätischer Mergelkalk, Weisser Riffkalk (lower part)], Kössen beds.

It will be recognised at once that this is an abbreviation of Pilcher's sequence. The main mass of the Weisser Riffkalk, which has all the characters of a true coral reef, has presented a difficulty to the author from the fact that he has found, in the lower parts, undoubted Rhætic fossils, and in other parts, which he considers are higher portions of the same group, Lias fossils have been discovered.

> "We are so accustomed to regard the term 'Oberer Dachsteinkalk' as applied to a Rhætic rock that it does not seem wise to use it for a group which is in part Rhætic, in part Liassic."

He therefore proposes "Weisser Riffkalk" as a local term, suggestive of the salient character of the group.

Before presenting the results of his own researches, Dr. Wähner devotes the first 78 pages to the discussion of the geological literature of the Sonnwend district. Commencing with Uttinger in 1819, he passes in review practically all that has been written on the subject up to 1900 (in the preface he comments on Ampferrer's paper of 1902). On each paper he makes a few brief explanatory or critical remarks. To Dr. Diener, however, he allots some fifteen pages, occupied almost wholly in destructive criticism—"a heap of errors," he says in one place; and he is so irritated by what he regards as Diener's incorrect observations and loose writing that he waxes ironical: "I regret I cannot give any figure of this interesting spot," says Diener, which causes the author to remark,

> "The reader endeavours to keep calm; perhaps D. had no time to make a sketch—but, on second thoughts, a better view is, that what Diener desires (*will*) to see, nobody *can* draw" (p. 40).

With much of the painstaking work of Pilcher, the author is in agreement, but he considers the

estimate of the number and thickness of the Lias and Jura deposits to be too great. In spite of Pilcher's care in selecting a traverse apparently free from complications, Wähner contends that thrusting and over-folding have produced a repetition of the beds.

In the chapter on stratigraphy, each member is dealt with in order. Incidentally, several points of interest are raised, such as the discovery in the Weisser Riffkalk of a true Coralline, to which the name *Cheilosporites Tirolensis* (Wähner) is assigned on account of its affinities with the modern Cheilosporum; there is also a doubtful Hydrozoan which more nearly resembles the Palæozoic Stromatoporoids than the Upper Jurassic Ellipsachinias and Sphæractinias, but is none the less morphologically nearest to the Triassic Spongiomorphidæ. Calcareous algæ, hydrozoa and corals contribute to the upbuilding of the reefs, but Dr. Wähner finds the last-named organisms predominating.

The greatest interest attaches to the "Radiolariengesteine" and the "Hornstein-Breccie." Dr. Wähner, in common with his predecessors, had been accustomed to regard the structure of this area as being far simpler than he now finds it. He demonstrates a large amount of thrusting and folding ("Aufwolbung"), the greater part of the movement having acted about the Hornstein-Breccie, the rocks above being comparatively little influenced. On all sides there are signs of pressure—brecciation, suture structure—and the term "Druckbreccien" is suggested as an expansion of Brögger's "Breccias *in situ*" for this widespread occurrence. The Hornstein-Breccie is proved to be a true "dislocation-breccia," and to contain blocks both of older and younger rocks.

In his anxiety to leave no doubt as to the tectonic origin of this breccia, the author appears to have somewhat laboured certain points that seemed to tell in his favour; for instance, he insists on the abyssal character of the over- and under-lying rocks because of the abundance of Radiolaria in them, especially the occurrence of a few Nassellarian forms—an argument that is not very safe, nor, in view of the other good evidence, is it very necessary. Again, the statement that the cloudy centres of some calcite crystals in the more or less marmorised limestones represent the finest powder of the crushed rock may be quite correct; but the same thing may be observed in semi-crystalline limestones of various ages, which have suffered no such considerable crushing, though it is true that the crystals more often exclude the impurities during their growth.

The author and his supporters, the *Gesellschaft z. förderung deutscher Wissenschaft, Kunst, u. Literatur in Böhmen,* may be congratulated on the production of an excellent piece of work. The continuation will be looked for with interest; it is to be hoped that Dr. Wähner, in addition to the half-promised geological map, will also furnish a series of photomicrographs of the numerous rock-sections he has examined.

J. A. H.

SHERBORN'S INDEX ANIMALIUM.

Index Animalium sive Index nominum quae ab A.D. MDCCLVIII *generibus et speciebus animalium imposita sunt, Societatibus Eruditorum adjuvantibus, a Carolo Davies Sherborn confectus. Sectio prima, a kalendis Januariis* MDCCLVIII *usque ad finem Decembris* MDCCC. *Cantabrigiae. E. typographico Academico* MDCCCCII. 1 vol. Pp. lix + 1195. (Cambridge: University Press, 1902.) Price 25*s.* net.

Darwin was so convinced of the pressing want of a dictionary of the names of plants that he devoted by his will a considerable sum of money to be employed in compiling such a work. This gigantic task, which was completed in 1895 by Mr. B. Daydon Jackson, and published by the University of Oxford under the title of "Index Kewensis," has been of enormous utility to working botanists. It was obvious that our zoologists would not be content without a similar convenience in their branch of natural science, and in 1890, accordingly, Mr. C. Davies Sherborn commenced his labours on the present work. His scheme for its preparation was set out in a letter published in this journal (Nature, vol. xlii. p. 54, May 15, 1890) and in "La Feuille des Jeunes Naturalistes," and suggestions for the improvement of the plan were at the same time invited from many working naturalists. After these had been studied, the scope of the proposed "Index Animalium" was finally defined as follows:—

(1) To provide a complete list of all the generic and specific names that have been applied to animals since January 1, 1758, when Linnæus inaugurated the binomial system.

(2) To give, as far as possible, an exact date for every quotation of a name.

(3) To give a reference to every name sufficiently exact to be intelligible to the specialist and the layman, so that they may know where to look for it.

Mr. Sherborn commenced regular work on July 1, 1890 After two years, an unfortunate breakdown in health, which interrupted more than once his assiduous labours, caused him to lose altogether three years, so that the actual time spent on the preparation of the present volume has been about eight years.

In 1892, the importance of the work was brought to the knowledge of the British Association, and a committee was appointed to assist its progress. The late Sir William Flower was its chairman, and Dr. Sclater, Dr. Henry Woodward and Mr. W. L. Sclater were other members. The committee has been reappointed every year, Dr. Woodward succeeding Sir W. Flower as chairman, and Dr. F. A. Bather becoming secretary when Mr. W. L. Sclater went abroad. The British Association has consistently supported the finances of the committee, and valuable contributions have been received from the Zoological Society of London and from the Government-grant fund of the Royal Society. Great assistance to the work has also been furnished by the permission of the authorities of the Natural History Museum to find storage and cabinets for the MS. of the work in the library at South Kensington, where the author has carried on most of his labours.

In 1897, in pursuance of a suggestion made by Dr.

Sclater, it was determined by the committee that in view of the long time that must elapse before the completion of the whole work, it should be divided into three portions—the first to contain names given from the beginning of 1758 to the end of 1800, the second those given from 1801 to 1850 inclusive, and the third those published in the latter half of the last century. We have now, therefore, before us the first o these three portions, from 1758 to 1800 inclusive. It is contained in one volume of 1195 closely printed pages, with about fifty-eight names in each page.

As the Clarendon Press had published the "Index Kewensis," it was supposed that the University of Oxford would gladly undertake the present work, and the first offer of it was made to Oxford. It was found, however, that such stringent terms were required there as could not be acceded to, and the sister University, being more liberally disposed, has thus obtained he honour of introducing to science the "Index Zoologicus."

OUR BOOK SHELF.

Vergleichende chemische Physiologie der niederen Tiere. By Dr. Otto von Fürth, Privatdocent and Assistant in the Chemico-physiological Institute of the University of Strassburg. Pp. xiv + 670. (Jena: Gustav Fischer, 1902.) Price 16 marks.

DR. OTTO V. FÜRTH has shown himself one of the ablest of the younger workers in the subject of chemical physiology, and he is already well known for his admirable researches on the subject of muscle-plasma and the chemistry of the suprarenal capsules. He has also contributed to physiological journals several interesting papers on the chemistry of invertebrates, which he has investigated during a stay at the zoological station at Naples. During his residence there, he appears to have inhaled with the sea breezes the proper invertebrate atmosphere for the carrying into execution of the present ambitious volume. Although the book is entitled the "Chemical Physiology of the Lower Animals," it relates mainly to the invertebrates, and at the end of each chapter is a brief summary contrasting these with the Vertebrata. Vertebrate physiology is fairly fully treated in all text-books of human physiology, and so the book meets what was a distinct want. Max Verworn, it is true, in his "General Physiology" approaches the subject by the study of the cell and of simple organisms, but the ground covered by v. Fürth's book is quite distinct from this.

The general scope of the book may be indicated by a brief enumeration of the subjects treated. After a few general chapters on the chemistry of the compounds met with in the animal kingdom and on the chemical composition of protoplasm, the first main heading is the blood, and this fluid in echinoderms, worms, molluscs, crustaceans, insects and tunicates is described. Breathing, nutrition and excretion are then treated under similar headings. Then the various animal poisons, and special secretions like mucin, the ink of cephalopods, silk, wax, &c., are described. The skeletal tissues, the pigments and the muscular tissues form the subjects of the next chapters, and at the end is an account of the genital secretions, under which, *inter alia*, a description of Loeb's experiments on artificial parthenogenesis is given.

It may be a matter of surprise to many well-informed physiologists what a large mass of material existed in relation to what has been regarded as the comparatively neglected subject of invertebrate physiology, and what interesting reading it makes when collected into an organic whole. Another general reflection will be what a vast field for research is still open to fill up the gaps in our knowledge.

The diligence the author has evinced in writing his book is beyond all praise. His lists of bibliographical references will prove most useful to future students of this branch of science Unlike many of his countrymen, he has consulted, not only those papers which are written in his own language, but he has been cosmopolitan in his reading. His aim, as just stated, has been an ambitious one, and we congratulate him most heartily on a decided success.

Thermodynamique et Chimie. Leçons élémentaires à l'usage des Chimistes. Par P. Duhem. Pp. ix + 496. (Paris: A. Hermann, 1902.) Price 12s.

THE second law of thermodynamics has had a curious history. It originated out of attempts to estimate the motive power of fire, it subsequently led to the notion of the thermodynamical potential, this in turn gave birth to the phase rule, and now it is in the domain of chemistry that the law obtains its most fertile applications. Prof. Duhem has already published a treatise in four volumes on thermodynamic chemistry, which has been reviewed in these columns ("Traité élémentaire de Mécanique chimique fondée sur le Thermodynamique." Paris, 1897-99), but a demand has arisen among chemists for a more elementary treatise, assuming but little knowledge of mathematics. As the author points out, the philosopher, the mathematician, the physicist and the chemist—he might have added the engineer—require separate treatises on thermodynamics.

Prof. Duhem confines himself to "three-day methods," that is, to methods formerly included in the syllabus of the first three days of the Cambridge Tripos—or, in other words, he uses neither calculus nor coordinate geometry, unless graphical representations are regarded as implying coordinate geometry. After an elementary introduction to the properties of the thermodynamic potential, he considers the phase rule, the properties of invariant, univariant, bivariant and multivariant systems, the displacement of the equilibrium state for variations of temperature and pressure, the properties of perfect gases, and the dynamics of false equilibria and explosions. The work appears to afford an excellent account of the large field of chemical investigation first started by Gibbs, Moutier and others which has led to such important results in the hands of van der Waals, Bakhuis Roozboom, van 't Hoff, Sainte Claire Deville, and a large army of still more recent workers

G. H. B.

Das Problem der geschlechtsbestimmenden Ursachen. By Dr. M. von Lenhossék, Professor of Anatomy in the University of Budapest. Pp. 99; 2 figs. (Jena: Gustav Fischer, 1903, published 1902.) Price 2 marks.

PROF. M. VON LENHOSSÉK gives us an admirably clear and scientific deliverance on the much-discussed problem of the factors which determine the sex of offspring. He takes account of most of the data and most of the theories, and comes to the conclusion that the determination is in the hands of the maternal parent and that the decision is given *prior to fertilisation.* He does not seem even to allow—what seems to us almost proved by the experiments of Yung and others—that the original bias may be altered in early stages of development. We adhere to the eclectic position that the determination of sex depends upon numerous variable factors, operative before, in and after fertilisation. The author's references to the literature on the subject are so numerous that we may point out the omission of any recognition of Starkweather, Hensen, Geddes and Thomson, Henneberg, Beard and Van Lint. J. A. T.

The Schoolmaster's Yearbook for 1903. *A Reference Book of Secondary Education in England and Wales.* Pp. lix + 351 + Part II. (unpaged) + 107. (London: Swan Sonnenschein and Co., Ltd.). Price 5*s.* net.

THIS is the first annual issue of what is likely to prove a useful work of reference for schoolmasters. It is divided into three parts, the first of which supplies general information concerning educational administrative authorities, educational associations, courses of training for teachers in secondary schools, and many similar subjects. The second part constitutes a directory of schoolmasters and others engaged in secondary education, while the third includes a number of miscellaneous articles and reviews. The first two sections will be useful to all who are interested in education, and if the editor adopts next year a larger number of abbreviations and gives only the important particulars about governing bodies and educational associations, he will increase considerably the value of the publication. The third part seems out of place; the articles it includes are more suitable for an educational periodical than an annual of this kind. The second part is an excellent first step towards the compilation of a register of teachers.

The Globe Geography Readers. By Vincent T. Murché. Introductory. Pp. 119. Price 1*s.* Junior. Pp. vi + 194. Price 1*s.* 4*d.* (London: Macmillan and Co., Ltd., 1902.)

THE plan of these books is sensible, and there is abundant evidence throughout that the author is intimately acquainted with the needs and limitations of young children. The information to be gained from the lessons is based upon observations and experiments of a kind which children can perform for themselves, and the conversational style will prove attractive to young readers. No lesson is overburdened with facts, and the author has been successful in proceeding always from the known to the unknown. We suspect that fathers of the kind introduced in these books, and uncles with sound geographical knowledge and a keen desire to instruct their nephews on every possible occasion, are rare in real life. It is a pity, too, that Mr. Murché refers to volcanoes as "mountains that blaze and smoke," and says that "flames and smoke burst out from the crater." The coloured plate of a volcano during an eruption shows a large number of volcanic bombs, though these products of an eruption are really very rare. The abundant illustrations add much to the value of what should prove to be two widely used books.

The Nature Student's Note Book. Part i. Nature Notes and Diary. By the Rev. Canon Steward, M.A. (Oxon.) Part ii. Tables for Classification of Plants, Animals and Insects in Full Detail. By Alice E. Mitchell. Pp. 152. (Westminster: Archibald Constable and Co., Ltd.)

THE teacher already possessed of a good working knowledge of biology and other branches of science included in nature-study will find Canon Steward's monthly notes useful as a reminder of which plants and animals are available for study at different times of the year; but the book is scarcely likely to be of much assistance to a non-scientific teacher who wishes to become a student of nature, with a view to introduce his pupils to the same study. It is questionable, too, if the introduction of gardening instructions into the notes will serve any good educational purpose. Miss Mitchell's tables are a little too technical for nature-study, and some of her definitions are not strictly accurate.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The late Sir G. G. Stokes.

THE eulogy of Stokes by Lord Kelvin contributed to your columns in terms so appropriately simple, a eulogy so sincere, as we all know, and more authoritative than could be pronounced by anyone else in the world, furnishes an incident that must impress the minds of all true lovers of science. It is not my purpose to intrude where I have no business, but I do feel most keenly the strong call there is to English men of science to see that the hidden work of Stokes does not remain any longer concealed. There is not the least doubt that his greatness and true worth escaped the observation of contemporaries outside the circle of real scientific workers, and there has been one conspicuous occasion quite recently when the order of his merit has been signally ignored.

About ten years ago the attention of Stokes was attracted to some work in which I was engaged, and this started a correspondence. I had no previous personal acquaintance with him, and I am sure he had no previous scientific acquaintance with me, but notwithstanding this he immediately placed the vast powers of his mind at my disposal, and assisted me with encouragement and advice that from my best friend would have been liberal in amount, whilst in value they could have been equalled from no other source. The abundance, lucidity and punctuality of his correspondence were amazing. I have had as many as three letters from him in one day, and on a particular occasion a telegram in addition, to say that he feared he had expressed himself in one of the letters with too much confidence. I was naturally not a little proud of this connection with a great man, but if my pride had tended to assume the form of vanity, that would have been frustrated by the discovery I was ever afterwards making of the apparently endless number of scientific workers who have received from Stokes the same unstinted help.

I wish, therefore, to express the hope that in any memoir of Stokes that is published there should be some attempt to gather the unostentatious testimony that would be so cheerfully given by those who are so much beholden to the great and good man who has passed from among us. It seems to me to be at the least a duty to scientific history to help our posterity to see clearly that the order of Stokes's merit as a man and a philosopher was that of Faraday and Newton.

CHEMICUS.

The Holy Shroud of Turin.

IN your issue of February 5, Mr. Worthington G. Smith says "the painter was so incompetent to deceive that he made the two head-tops touch." There is some mistake here. M. Vignon's reproductions of Signor Pia's photographs show quite a large space—nearly equal to the height of the head—between the two head-tops. From Mr. Smith's diagram I infer that he has mistaken one of the waterstain outlines for the head-top of the back view figure. If so, I do not wonder at his thinking the painter "incompetent."

The hypothesis of a painted positive turned negative, to which most of your correspondents seem to incline, presents one difficulty which I have not as yet seen noticed. No one would paint a shaded positive by way of simulating a supposed soiling of the shroud by the presence of the body within it; the intention must have been to make a *picture*—to represent a miraculous impression, perhaps, but still a *pictorial* one, else why a positive? Then, such a picture would naturally be shaded for a more or less side light, so that the originally light and now dark portions would be more or less on one side of the various limbs and features, instead of in their centres as they actually show on the shroud.

R. E. FROUDE.

Gosport, February 8.

The Principle of Activity and Lagrange's Equations. Rotation of a Rigid Body.

THERE are some people who understand by Newton's second law of motion nothing more than the three equations of motion for a body which can be treated as a particle, viz., $m\ddot{x} = X$, &c. (or rather the equivalent equations for impulsive forces). Such people, however, would probably not seriously object to any dynamical truth whatsoever, from the conservation of energy to the principle of varying action, being read into this law, if only he who does so would explain clearly his own interpretation of Newton's statement. I, for one, am a little curious to have stated fully the principle which justifies Mr. Heaviside in his letter in your issue of January 29 in deducing from the solitary equation

$$\dot{T} = \left(\frac{d}{dt} \cdot \frac{dT}{dv_1} - \frac{dT}{dx_1}\right)v_1 + \ . \ . \ .$$

that "*by Newton*, the force on x_1 is the coefficient of v_1."

It is a sufficient indication either of an incorrect premiss or of bad logic, however obscure an argument may be, if the conclusion be wrong; one does not readily see from Mr. Heaviside's letter how he could object to his method being applied directly to the motion of a rigid body with one point fixed, in which case, as is well known, taking

$$2T = A\omega_1^2 + B\omega_2^2 + C\omega_3^2$$

it leads to a wrong expression for the external couple round the axis of x, viz. $A\dot{\omega}_1$ instead of the correct one, $A\dot{\omega}_1 - (B - C)\omega_2\omega_3$.

W. McF. ORR.

Royal College of Science, Dublin, February 2.

PROF. ORR's opening remarks perhaps indicate that the want of appreciation of Newton's dynamics is even greater than I supposed. My authority for Newton is that stiff but thorough-going work, Thomson and Tait. On comparison, I find that Prof. Orr's "some people" seem to overlook the vitally important third law, without which there could be no dynamics resembling the reality, and also the remarkable associated scholium "Si æstimatur . . .," enunciating the principle of activity, which is of such universal and convenient application, both by practicians and by some theorists. In my short outline of the beginning of the theory of Lagrange's equations, my argument "by Newton" referred to the activity principle.

The example of failure given by Prof. Orr is remarkable in more than one way. If the three coordinates specified the configuration, then the equations of motion would come out in the way indicated. It is clear, therefore, from the failure that in the concrete example of a rotating rigid body, the coordinates employed, which are the time-integrals of the angular velocities about three moving axes, are not proper Lagrangian coordinates within the meaning of the Act. If we use coordinates which do fix the configuration (Thomson and Tait, § 319), there is no failure.

But it is quite easy to avoid the usual complicated trigonometrical work, and obtain the proper equations of motion by allowing for the motion of the axes. Thus, if **a** is the angular velocity, the angular momentum is

$$\mathbf{i}\frac{dT}{da_1} + \ . \ . \ . = Aa_1\mathbf{i} + Ba_2\mathbf{j} + Ca_3\mathbf{k},$$

and the torque is its time differentiant, that is,

$$\mathbf{F} = A\dot{a}_1\mathbf{i} + B\dot{a}_2\mathbf{j} + C\dot{a}_3\mathbf{k} + Aa_1\frac{d\mathbf{i}}{dt} + Ba_2\frac{d\mathbf{j}}{dt} + Ca_3\frac{d\mathbf{k}}{dt}.$$

Here **i**, **j**, **k** are unit vectors specifying the directions of the principal axes. They only vary by the rotation, so $d\mathbf{i}/dt = V\mathbf{ai}$, &c., and this makes

$$\begin{aligned}\mathbf{F} &= Aa_1(\mathbf{j}a_3 - \mathbf{k}a_2) + Ba_2(\mathbf{k}a_1 - \mathbf{i}a_3) + Ca_3(\mathbf{i}a_2 - \mathbf{j}a_3) + A\dot{a}_1\mathbf{i} + \ . \ . \ . \\ &= \mathbf{f}\{A\dot{a}_1 - a_2a_3(B - C)\} + \mathbf{j}\{. \ . \ .\} + \mathbf{k}\{. \ . \ .\}.\end{aligned}$$

This exhibits Euler's three well-known equations of motion round the three principal moving axes.

In general, $T = \frac{1}{2}\mathbf{a}M\mathbf{a}$, where M is a vectorial matrix (or linear vector operator), fixed in the body. Then the momentum is $M\mathbf{a}$, and the torque is

$$\mathbf{F} = M\dot{\mathbf{a}} + \dot{M}\mathbf{a} = M\dot{\mathbf{a}} + (V\mathbf{a}M)\mathbf{a}.$$

This allows M to be specified with respect to any axes fixed in the rotating body. Of course, the principal axes are the best. I may refer to my "Elec. Pa.," vol. ii., p. 547, footnote, for details of a similar calculation relating to the torque (and activity thereof) produced in an eolotropic dielectric under electric stress.

The following concisely exhibits the necessity of allowing for variation of M, and how it is done in the general case of n independent variables:—Let $T = \frac{1}{2}\mathbf{v}M\mathbf{v} = \frac{1}{2}\mathbf{pv}$. Then **v** is a "vector" or complex of n velocities, and $\mathbf{p} = M\mathbf{v}$ is the corresponding momentum, whilst M is a symmetrical matrix. By differentiation to t,

$$\dot{T} = \mathbf{v}(M\dot{\mathbf{v}} + \tfrac{1}{2}\dot{M}\mathbf{v}) = \mathbf{Fv} \quad \text{(Hamilton)},$$

or

$$\dot{T} = \mathbf{v}(\dot{\mathbf{p}} - \tfrac{1}{2}\dot{M}\mathbf{v}) = \mathbf{Fv} \quad \text{(Lagrange)}.$$

Here **F** is the force on the system, in the same sense as **v** is the velocity of the system. For $\dot{M}$ substitute $v(dM/dx)$, to come to the usual forms by breaking up into n components. But the above are more general, because M may vary independently of x. Activity should be the leading idea.

OLIVER HEAVISIDE.

Insects and Petal-less Flowers.

I WAS much interested by Mr. Bulman's account of Prof. Plateau's experiments in the matter of insects' visits to petal-less flowers in the issue of NATURE for February 5 (p. 319), wherein it is stated that Prof. Plateau contends that insects "are not attracted by the brilliant colours of the blossoms, but rather by the perception in some other way—probably by scent—that there is honey or pollen."

It has not been my good fortune to read Prof. Plateau's own account of the experiments which led him to the above conclusion, but it certainly appears to me, from your correspondent's summary, that he is generalising from an observation which has only a strictly limited application.

We are told that in the case of thirty poppies artificially deprived of their petals, as compared with seventy intact poppies, the average visits were as 4·5 is to 2·4, the most striking case instanced being that of the Dipterous insect *Melanostoma mellina*, the visits of which were as 4 is to 0.

The experiment and its result does not, to my mind, in the least tend to bear out the theory it is advanced to support, though your correspondent gives the method his approval.

I do not wish to doubt the possibility of smell playing a part in attracting insects, but I certainly cannot see that the artificial removal of the coloured petals proves that colour has no influence. We are fond of attributing great intelligence and power of perception to the bee, and yet in this case the insect is not even given credit for being able to recognise what are known to it, from possibly long experience, as the essential parts of the flower! Because we buy well advertised goods, and still continue to buy them when their proved virtue renders advertisement a thing of the past, is it proof that the advertisement played no part in determining our choice? The answer is obvious.

The greater number of insects visiting the poppies shorn of their petals might easily be accounted for, especially in the case of the Diptera, by the presence of some attractive substance in the sap exuded from the cut tissues, and probably by the resulting greater accessibility.

As a contrast to this experiment I would mention that of Lord Avebury, which loses none of its significance through being described in a popular magazine (the *London*, Christmas number). Quantities of honey were taken and laid on glass slips, and a marked bee was trained to come to a certain spot for it. The honey was supplied on slips of six different colours—blue, red, yellow, orange, green and white—and on one plain slip. Lord Avebury so arranged matters that the bee was persuaded to visit each and every slip before returning to the hive, the method being as follows:—

Seven slips in a row on lawn; the bee arrives and alights on (say) blue; it is allowed to remain for a few seconds and then driven off, the blue slip being withdrawn; it then goes to (say) white; after a few seconds at white the bee is again driven off, and goes to (say) yellow, the white slip being also withdrawn; after having visited all the slips in this way, and being at last deprived of every one, the bee goes back to the hive.

During the bee's absence the glasses are replaced, but in different order, and on the insect's return it is again noted which slip receives first attention.

Out of a hundred such complete rounds Lord Avebury

found his bee went to the blue glass *first* thirty-one times, and *last* only four times, while the plain glass came in for first notice only five times, and last twenty-four times. The other colours occupied intermediate positions in the bee's favour.

Here we have a case of which the bee could not possibly have had previous experience, and where every precaution was taken to avoid any undue advantage of position, &c., being given to any particular colour, with a result going far to prove that all other conditions being alike, colour does play an important part in deciding an insect's choice.

I would suggest that the correct method of settling the question would be to cut away, not the petals, but the stamens, &c. Then if insects continued to visit flowers so mutilated we should have grounds for thinking that petals exercise some attraction, or *vice versâ*.

E. Ernest Lowe.

Municipal Museum and Art Gallery, Plymouth,
February 9.

Science and the Education Act of 1902.

In two letters to you last year, I drew the attention of scientific men and of others interested in the welfare of our country and empire to the inferior position which scientific studies continue to hold in the education of the youth of this country (see Nature, vol. lxvi. pp. 350, 459). One hoped that the Education Act of 1902 would do something to remedy present defects. That hope, it is to be feared, is in a poor way of being realised, so far as any inference can be drawn from the composition of the "Education Committee" recently appointed by the Council of a county so near to the metropolis as Hertfordshire. The whole thing is little better than a jumble, the sort of thing one would expect from the manipulation of a county-directory in a solicitor's office. So little did the County Council appear from the newspaper report to realise the gravity of the task before them that they adopted *en bloc* and without criticism the list prepared for them by the Clerk of the Peace, whose first-hand knowledge of education can only be at the best extremely limited. The committee-list bristles with names of county respectability, including a noble earl, a few M.P.'s, a fair sprinkling of J.P.'s, and among the C.C.'s elected very few appear to have taken a degree at any university, while one solitary name appears as a representative of science in that of Sir John Evans, F.R.S., who might have been a little more vigilant in this matter.

Outside the Council, we find the name of the Dean of St. Albans, a scholarly, clear-sighted, large-minded man, an acquisition to any committee; then the names of the two *classical* head-masters of Haileybury and Berkhampstead, men of the type referred to in my previous letters (*supra*), who cannot be expected to appreciate the importance of scientific education, but whose position in the educational world will give adventitious value to their opinions among the rank and file of the educational ignoramuses. In a list of some twenty-one, one solitary name, that of the young head-master of a not very important school in this neighbourhood, appears as a representative of science. It does not appear that a single representative of the Army or Navy or a single graduate in science or medicine finds a place on the committee; and such men resident in the county as my neighbour the principal of the Diocesan Training College (who is zealously engaged in attempting to train elementary teachers on scientific lines), or the official secretary of University College, or myself (with a record of more than a quarter of a century of public-school and scientific work) seem to have been the last people to be thought of.

In the light of the above facts, can it be unfair to say that the cause of progressive education in the county of Herts has drifted? And if this can happen in a county so near London, what is likely to happen in the more remote counties, where provincial ideas prevail more strongly? Is it not time that the leading scientific societies, led by the Royal Society or by the British Association, should draw up a memorandum impressing upon the county and borough councils of the country the serious call made to them by the Education Act to do their best to strengthen the sinews of the intellectual war, which (*nolens volens*) this country must be prepared to carry on? Had there been a single man of light and leading in the Cabinet, such instructions might have been included in the Act or its preamble as to render such action unnecessary. But so beclouded were the minds of our legislators in the long, dreary strife of bigotry and partisanship of last autumn that they seem to have lost sight of higher intellectual issues altogether. Let us hope that in the great provincial centres such an important point as the due representation of scientific education on the educational committees will not be lost sight of. A. Irving.

Hockerill, Bishop's Stortford, February 6.

RADIO-ACTIVITY OF ORDINARY MATERIALS.

It is now well recognised that the air in any ordinary vessel possesses the power of conducting electricity, although to a very slight extent. It has been usual to refer to the effect as the "spontaneous ionisation" of the air. This name suggests that the conductivity is in some way an essential property of the air, just as the electrical conductivity of metals is inseparably connected with the nature of those bodies. Mr. C. T. R. Wilson, however, has found (*Proc.* Roy. Soc., vol. lxix. p. 277) that, when other gases are substituted for air, the relative ionisations are in nearly the same ratio as those which I observed for the same gases under the action of Becquerel radiation (*Phil. Trans.*, 1901, p. 507). Further, Mr. J. Patterson (*Proc.* Camb. Phil. Soc., vol. xii. p. 44) has found that, when a large vessel is used, the amount of ionisation is not proportional to the pressure, but tends towards a limit, when further increase of pressure no longer affects it. This is exactly the behaviour that might be expected if the effect was due to a feeble radio-activity of the walls of the vessel, the radiation being easily absorbed by the air.

I have recently carried out a series of experiments with a view to decide whether the nature of the walls of the vessel had any influence on the rate of discharge of a charged body inside it.

The various materials were made into cylinders, 13 cm. long and 3·4 cm. in diameter. A central wire, charged, and connected with an electroscope, formed the leaking system. The electroscope was exhausted, so as to avoid any leakage through the air in it, and, before each experiment, the insulation, which was of lead-glass tube, dried by the exhaustion of the vessel in presence of phosphoric anhydride, was tested. No leakage could be detected. On admitting dried air, a small leakage immediately set in, and its amount could be measured by timing the movement of the gold leaf over the scale division of a microscope with micrometer eyepiece focussed upon the leaf.

The leakage in scale divisions per hour, with various materials surrounding the charged wire, is given below:—

Tin foil	3·3
Ditto, another sample	2·3
Glass coated with phosphoric acid	1·3
Silver, chemically deposited on glass	1·6
Zinc	1·2
Lead	2·2
Copper (clean)	2·3
Ditto, thoroughly oxidised	1·7
Platinum (various samples)	2·0, 2·9, 3·9
Aluminium	1·4

It appears, then, that there are very marked differences in the rate of the leak, when different materials constitute the walls of the vessel. There can therefore be little doubt that the greater part—if not the whole—of the observed ionisation of air is not spontaneous at all, but due to Becquerel rays from the vessel.

It is, I think, interesting to find that the phenomena of radio-activity, which have generally been regarded as rare and exceptional, are really everywhere present.

The rate of leak with various pieces of tin foil from the same stock was always the same, as nearly as the experiments could show—that is, to within about 6 per

cent. But, as may be seen in the table, a piece from another stock gave a different amount of leakage. The same holds good for platinum, one specimen tried being twice as active as another. It was found that ignition did not affect the radio-activity of a given specimen of platinum.

In order to compare the activity of the substances mentioned above with that of uranium, a small crystal of uranium nitrate, measuring 12×4 mm., was cemented to the inside of one of the cylinders; the rate of leak due to it was found to be thirteen times that due to the most active cylinder of platinum. The area of the uranium was only 1/240th part that of the platinum, so that its activity for an equal area would be no less than 3000 times greater. It is possible that the radio-activity of ordinary materials may be due to traces of the more active substances. This would explain the varying activities of different samples of the same metal. Only an infinitesimal proportion of radium would be required. Radium is 100,000 times more active than uranium, and uranium 3000 times more active than the most active common material that I have experimented with. So that one part of radium in three hundred million would suffice to account for the observed effects.

R. J. STRUTT.

OYSTERS AND TYPHOID FEVER.

THE recent outbreaks of typhoid fever at Winchester and at Southampton have again directed public attention to the risk of typhoid infection due to the laying down of edible forms of shell-fish in sewage-polluted waters.

So long ago as 1895, in a report made by Dr. Bulstrode to the Local Government Board, it was pointed out that few of the oyster layings, fattening beds or storage ponds round the English and Welsh coasts could be regarded as free from possible sewage contamination. In consequence of this report, the Local Government Board in 1899 introduced a Bill providing that the various county and borough councils should ascertain from time to time the sanitary conditions of the oyster layings and empowering these bodies to take action if sewage pollution were proved. This Bill, which dealt only with oysters, after having been read a second time, was withdrawn. Apparently nothing has since been done, matters have been allowed to drift, and in consequence several outbreaks of disease have occurred, with loss of valuable lives, and an important industry is threatened with temporary ruin.

In 1901, the medical officer of health for Westminster reported on certain cases of typhoid fever seemingly due to contaminated cockles, from some of which a bacillus, having all the characters of the typhoid bacillus, was isolated at the Jenner Institute of Preventive Medicine.

Dr. Nash, the medical officer of health for Southend-on-Sea, reported upon the incidence of typhoid fever in that borough during 1901, and found that in no less than twenty-one out of thirty-seven cases of the disease there was a history of the eating of shell-fish (generally oysters and cockles) within a month of the onset of the disease, *i.e.* within the incubation period. From a report by Dr. Allan, medical officer of health for the City of Westminster, mussels also seem to be implicated.

Attacks of illness, attributable to the eating of shell-fish, in the Borough of Wandsworth and the City of Westminster having been brought to the notice of the Corporation of the City of London, the last-named body has taken action. The responsibility of the City Corporation in this matter is great, for not only are the majority of the cockles and many of the oysters implicated exposed for sale in the City, but the former shell-fish is mostly obtained and relaid within the City's jurisdiction. The City Corporation has therefore caused a number of samples to be bacterioscopically examined by Dr. Klein, and his reports show that a larger or smaller proportion of the samples examined from *every* district shows evidence of sewage contamination, and from certain cockles the typhoid bacillus has actually been isolated.

The question then arose as to dealing with an obviously infected and dangerous source of food supply. Under the Public Health (London) Act 1891, it is possible to obtain a justice's order to destroy such unwholesome food, but the necessary examination to establish the fact involves a lapse of several days, and before the results of such examination could be known, the whole quantity of the sample implicated would have been consumed. In the circumstances, the facts were reported to the Worshipful Company of Fishmongers, which has extensive powers over the fishing industry throughout the country, and the Company's inspectors are now engaged in a survey of the various sites of the shell-fish fisheries and are taking steps to stop the sale of contaminated molluscs.

It might have been thought that sea-water would be prejudicial to the typhoid bacillus, but such does not appear to be the case. The experiments of Dr. Klein and of Prof. Boyce have shown that although the organism does not multiply, it retains its vitality in sea-water for at least three or four weeks. In the infected oyster it lives for two to three weeks or more, and even when washed in pure running sea-water, the infective properties may be retained for several days.

As regards cockles, these are "cooked" before consumption, and thorough cooking would be fatal to the typhoid bacillus. But it seems that the "cooking" of cockles is a very perfunctory process, and consists in simply plunging nets filled with the molluscs into boiling water, so that many might (and obviously do) escape the full action of the heat; actual boiling renders them tough and uneatable.

Legislative enactments and periodical inspections are obviously necessary to protect the public from the risk of infection from sewage contaminated shell-fish, and should be welcomed by the merchants and their employés whose livelihood depends upon this important industry. So far back as 1894, the value of the oysters alone landed by English dredgers in that year amounted to 84,271*l*.

R. T. HEWLETT.

MR. MARCONI AND THE POST OFFICE.

THE fact that the message from the King to President Roosevelt, in reply to the latter's wireless telegram of greeting, had to be sent to America by cable occasioned at the time much comment and correspondence in the daily papers on the attitude of the Post Office towards Mr. Marconi; the subject cropped up again last week on the return of Mr. Marconi to this country after his successful expedition to America. There is some little difficulty in ascertaining the real state of the case, as two or three different explanations have been put forward in the papers, but the truth of the matter seems to be precisely what we stated in our notes columns four weeks ago. In an interview with a representative of the *Daily Express*, Mr. Marconi made the following statements:—

"We asked the Post Office authorities whether they would allow us to connect our station at Poldhu by wire with Mullion—at our own expense, mind you—but they refused absolutely and entirely."

"The message (that from the King) was not received at our offices until after Mullion Post Office had closed for the night, and one cannot very well keep a King's message

lying about for twelve hours. I think it would have been much more discourteous to the King to have kept his message waiting for a day than it was to send it by cable."

It seems, therefore, that the King, having sent his reply to the London office of the Wireless Telegraph Company, the company could not send it on to Poldhu for transmission to America on account of the fact that it was impossible at night to wire from London to Poldhu: they were compelled, in consequence, to send the message by cable, the cable companies possessing the advantage of a direct connection between the Post Office lines and the shore ends of their cables. It is a similar connection for which the Marconi Company asks and offers to pay, but which the Post Office declines to grant.

In these circumstances it is not surprising that Mr. Marconi's feelings towards the Post Office are rather bitter, and that he proposes to make no further additions to the Poldhu Station until the authorities have decided what they intend to do. He now proposes to go to Italy and build a huge station there, probably at Rome, partly, no doubt, because, as he says, "Abroad I can get everything I want. Here in England I can get nothing." This is a little sweeping, for all England has not been so backward in supporting Mr. Marconi's enterprise as the officials of the Post Office. The attitude of the Post Office, however, certainly seems inexcusable, and we do not see by what reasonable arguments it can be supported. It has been urged that, until Mr. Marconi has been able to convince a jury of Government officials and independent experts that his system is capable of satisfying stringent tests of trustworthiness for a definite period under definite conditions, the Post Office is fully justified in withholding its recognition and support. This argument seems to us unsound. If the Post Office is not satisfied that Transatlantic wireless telegraphy is trustworthy, let it, by all means, send its own messages by cable; but is this any reason why the man in the street—or the King—who wishes to benefit by any advantages in tariff or otherwise, which the Marconi Company may offer, and who is willing to run the risk of his message getting lost on the way, or read by Mr. Maskelyne at Porthcurnow, should be denied the necessary facilities? Or is it any reason why the more enlightened Governments of Canada and the United States should be penalised by having their messages delayed, as we suppose must now occur if they arrive by night?

It seems to us that the correct thing for the Post Office to do is to grant the Wireless Telegraph Co. the facilities for which it asks without delay, lest the Post Office be accused, with some justice, of blocking the progress of an enterprise of great promise. Whether Transatlantic wireless telegraphy will prove of commercial value or not time will show; the shareholders may be relied upon to put an end to it soon enough if it neither pays nor gives prospect of paying. Should it, as some sanguine people think, prove better than the submarine cable, and ultimately supplant it, the cable companies will have to suffer that the world at large may gain; it will not be the first time in history that the old order has given place to the new. But none of these questions, commercial or technical, seems to us to be the concern of the Post Office, which should only desire to facilitate a new means of communication in which, rightly or wrongly, a large portion of the general public have considerable confidence.

In the meantime, the development of wireless telegraphy progresses rapidly in other directions, and especially in the direction in which we have always maintained it would be most serviceable, namely, in increasing the safety and relieving the monotony of travelling by sea. Reports are continually appearing in the papers of ships communicating with one another, or with the shore, for some time prior to their arrival. Reuter's Agency has been experimenting in transmitting news to ships, and last week the *Minneapolis*, thirty-six hours before its arrival, was put in possession of all the latest news, much to the satisfaction of the passengers. Reuter's Agency, it is said, looks forward to the time when it will be able to maintain a daily news service right across the Atlantic. The day is possibly not far distant when it will be possible for all ships to keep in constant communication with land, and if this result is attained, wireless telegraphy will have scored a great and lasting success; but to derive the greatest benefit from such an achievement in this, as in the Transatlantic service, the Post Office must cooperate and not oppose progress. We trust someone will ask Mr. Balfour if it is the intention of the Government to bar all scientific progress.

Maurice Solomon.

THE CONSTITUTION OF THE NEW EDUCATION COMMITTEES.

VARIOUS applications have been made to the Board of Education for suggestions with respect to the constitution of education committees under the new Education Act, and the framing of schemes for the purpose. With a view to assist councils who have not as yet framed schemes for themselves and desire assistance, the Board of Education issued on February 12 a memorandum making suggestions as to the main matters which should be provided for by the scheme. The Act itself lays it down that every scheme shall provide for the appointment by the council of at least a majority of the committee, and the persons so appointed shall be persons who are members of the council, unless, in the case of a county, the council shall otherwise determine; for the appointment by the council, on the nomination or recommendation, where it appears desirable, of other bodies (including associations of voluntary schools), or persons of experience in education, and of persons acquainted with the needs of the various kinds of schools in the area for which the council acts; for the inclusion of women, as well as men, among the members of the committee; and for the appointment, if desirable, of members of school boards existing at the time of the passing of the Education Act as members of the first committee.

The memorandum referred to contains a model scheme, which goes a long way towards elucidating what, in the opinion of the Board of Education, is to be understood exactly by the words "nomination or recommendation" in the Act. This part of the model scheme reads as follows:—

Nominated members, one nominated by each of the following bodies, *e.g.*:—
The council of the University of ;
Recommended members, one recommended by each of the following bodies, *e.g.*:—
The Chamber of Commerce of ;
The Agricultural Society of ;
The Association of ;
The Governing Body of the ;
An electing body consisting of .
Members appointed after consultation with:—
The

It is of great importance that the Board of Education appears to contemplate that the right of nomination will belong to universities alone, while other associations and institutions can merely recommend persons for appointment by the council. Moreover, the memorandum refers to the representation of the interests of University education, and as we believe this is the first time in which the work of Universities has been mentioned as coming within the sphere of the Act, it is important to direct particular attention to this point.

The reference to University education occurs in the part of the memorandum which interprets what is meant by the words "persons of experience in education and of persons acquainted with the needs of the various kinds of schools." The interests which are always to be represented either among the members appointed from the council or among members appointed from outside the council are thus enumerated:—University education; the secondary education of boys and girls in its higher and lower grades; technical instruction and commercial and industrial education, having special regard to the industries of a particular district; the training of teachers; and elementary education in council schools and in voluntary schools.

The Board of Education evidently does not intend that the councils concerned with the appointment of education committees shall be allowed to lose sight of the needs of higher and secondary education. It is earnestly to be desired that men of science in all parts of the country will be willing to become members of these education committees, so that councils everywhere may be kept informed as to what must be done if, as a nation, we are to make up the leeway in our educational affairs as compared with those of, say, Germany and the United States.

NOTES.

THE Bakerian lecture of the Royal Society on Thursday next, February 26, will be delivered by Mr. C. T. Heycock, F.R.S., and Mr. F. H. Neville, F.R.S., on "Solid Solution and Chemical Transformation in the Bronzes."

WE regret to see the announcement that Mr. F. C. Penrose, F.R.S., died on Sunday last at the age of eighty-five. From an obituary notice in the *Times* we learn that Mr. Penrose was born at Bracebridge, near Lincoln, and, after four years at Bedford Grammar School, entered the foundation at Winchester College. At Cambridge he was a senior optime in the Mathematical Tripos in 1842, and for three years thereafter he held the appointment of Travelling Bachelor to the University. In 1851 he brought out, for the Society of Dilettanti, a work entitled "The Principles of Athenian Architecture," of which a second edition has been published. In the following year he was appointed Surveyor of the Fabric of St. Paul's Cathedral, a post which he held until 1897. He published in 1869 "A Method of Predicting Occultations of Stars and Solar Eclipses by Graphical Construction," of which a new edition was issued last year; and during 1893 he contributed to the *Transactions* of the Royal Society a paper on the astronomical significance of the orientation of Greek temples, which was followed by a supplement on the same subject in 1897. His last work was an endeavour to determine the age of Stonehenge by utilising the orientation theory combined with accurate measurement of the direction of the axis of the building. It is rarely that the scientific and artistic temperaments are found so closely united in one man. His death is a loss both to science and art, which will be widely felt.

AT the Cambridge Philosophical Society on February 2, the president, Dr. Baker, proposed from the chair, "That the Cambridge Philosophical Society desires to express its sense of the great loss sustained by the University and the Society in the death of Sir George Gabriel Stokes, to whom the Society was bound by so many ties of obligation and reverence." This was seconded by Prof. Thomson, and carried unanimously. The Society then adjourned, as a mark of respect to Stokes's memory.

AT a conference of botanists of Vienna held on December 9, 1902, the organising committee was elected for the International Botanical Conference which is to be held at Vienna in 1905. The officers of the committee are as follows:—Honorary presidents: Dr. Guillaume de Hartel, Minister of Public Instruction; Dr. Charles de Giovanelli, Minister of Agriculture; Prof. Edouard Suess. Presidents: Prof. Richard de Wettstein and Prof. Jules Wiesner. Vice-presidents: Prof. Edouard Hackel and Prof. Hans Molisch. General secretary: Dr. Alexander Zahlbruckner. Secretaries: Dr. Charles Linsbauer and Dr. Frédéric Vierhapper. Treasurer: Dr. Léopolde de Portheim. All communications concerning the congress should be addressed to the general secretary, Dr. A. Zahlbruckner, Vienne, I., Burgring 7.

THE biennial Hunterian Oration was delivered on the afternoon of February 14 by Sir Henry Howse, president of the Royal College of Science, in the theatre of the college. He devoted the greater part of his oration to interesting biographical incidents concerning John Hunter, who was elected a fellow of the Royal Society in 1767, and appointed surgeon-extraordinary to the King in 1776. The collection of the objects in his museum was Hunter's chief interest through many years of his life, and at his death there were 14,000 specimens in the museum, on which Hunter spent 70,000*l.* A banquet took place in the evening in the library of the college, at which the honorary fellowship of the college was conferred on Lord Roberts, who, in his reply, referred to the outbreaks of enteric fever at Bloemfontein and Kroonstad during the late war, and expressed his admiration for the way in which the medical officers managed to meet all emergencies with a minimum of appliances.

THE Rumford Committee of the American Academy of Arts and Sciences has made the following grants in aid of investigations in light and heat:—250 dollars to Dr. Ralph S. Minor, of Little Falls, N. Y., for a research on the dispersion and absorption of substances for ultra-violet radiation; 100 dollars to Dr. Sidney D. Townley, of Berkeley, Cal., for the construction of a stellar photometer of a type devised by Prof. E. C. Pickering and already in use in the study of the light of variable stars; 200 dollars to Prof. Edwin B. Frost, for the construction of a special lens for use in connection with the stellar spectrograph of the Yerkes Observatory to aid in the study of the radial velocities of faint stars; 250 dollars to Profs. E. F. Nichols and G. F. Hull, of Dartmouth College, for their research on the relative motion of the earth and the ether; 300 dollars to Prof. G. E. Hale, of the Yerkes Observatory, for the purchase of a Rowland concave grating to be used in the photographic study of the spectra of the brightest stars.

AT a meeting of the Royal Commission for the Exhibition of 1851, held on February 10, the Prince of Wales was unanimously elected president of the Commission in succession to His Majesty the King, who had held that position since the year 1870. In taking the chair, the Prince of Wales remarked:—"The history of the Commission seems a somewhat curious one. Originally appointed merely to carry out the great Exhibition of 1851, it was afterwards charged with the duty of disposing of the sum of 180,000*l.*, the profit resulting from that Exhibition, a task which, in ordinary circumstances, might have been speedily completed. But the happy investment of the bulk of the money in the Kensington Gore estate gave the Commission a permanent character. The acquisition of the estate and its subsequent great increase in value has enabled the Commissioners to afford considerably more help in the promotion of science and the arts than could have been anticipated from the sum of money originally at their disposal. Without going into detail, the Commissioners are aware that

their body, by granting sites for public institutions (in most cases gratuitously, in others on very liberal terms), by grants of money in aid of those institutions, and by scientific and educational scholarships administered by the Commission, have already carried out to a very large extent the trust of their charter."

Prof. H. G. Seeley, F.R.S., has been elected a foreign correspondent of the Imperial Academy of Sciences, St. Petersburg.

Prof. Frederick W. Putnam, curator of the Peabody Museum, has been awarded the Lucy Wharton Drexel medal of the Franklin Institute of Philadelphia for his work in American archæology.

We learn from *Science* that Dr. W. A. Cannon has been appointed resident investigator of the Desert Botanical Laboratory of the Carnegie Institution. Mr. Frederick V. Coville and Dr. D. T. MacDougal, of the advisory board of the laboratory, started on January 24 on a tour of inspection of the region west of the Pecos River, in Texas, along the Mexican boundary, for the purpose of fixing upon a site for the laboratory.

On Tuesday next, February 24, Sir William Abney will deliver the first of a course of three lectures at the Royal Institution on "Recent Advances in Photographic Science." On February 26 Prof. L. C. Miall begins a course of three lectures on "Insect Contrivances," and on Saturday, February 28, Lord Rayleigh delivers the first of six lectures on "Light; its Origin and Nature." The Friday evening discourse on February 27 will be delivered by Mr. A. Liebmann on "Perfumes; Natural and Artificial"; on March 6 by Prof. J. G. McKendrick, on "Studies in Experimental Phonetics"; and on March 13 by Prof. Karl Pearson, on "Character Reading from External Signs."

The Carnegie Institution has made a grant of four thousand dollars to the Yerkes Observatory, to be expended under the direction of Prof. George E. Hale, for certain researches in astronomy and astrophysics. These will comprise:—(1) A photographic investigation of stellar parallaxes; (2) investigations in stellar photometry; (3) a detailed study of several hundred photographs of the sun, taken with the spectroheliograph at the Kenwood Observatory in the years 1891–1896; (4) certain investigations in solar and stellar spectroscopy, to be undertaken by Prof. Hale as soon as the new horizontal reflecting telescope, recently injured by fire, has been completed.

The funeral of the late Mr. James Glaisher, F.R.S., at Shirley, near Croydon, on February 11, was attended by a representative gathering of scientific men, as well as by many personal friends. Major MacMahon represented the Royal Society, and, on behalf of other societies and institutions, there were present, among others, Mr. F. W. Dyson, chief assistant of the Royal Observatory, Greenwich; Sir Charles Wilson, chairman of the executive committee of the Palestine Exploration Fund; Mr. W. Ellis, late of the Royal Observatory; Mr. W. Marriott, assistant secretary of the Royal Meteorological Society; Mr. Baldwin Latham and Mr. A. H. Baynes. Among the floral tributes were wreaths from Mr. W. N. Shaw, Secretary to the Meteorological Council; the Palestine Exploration Fund, the Aëronautical Society of Great Britain and the Aëronautical Society of Germany.

The *Etoile Belge* states that an international exhibition will be opened at Liège in April, 1905. The exhibition, which will include a scientific section, is due to private initiative, but it has received the patronage of King Leopold, and has been promised the support of the Belgian Government.

In their twelfth annual report, the committee of the Society for the Protection of Birds is able to announce a decided advance in the object for which it is striving. The Wild Birds Protection Act of 1902 has considerably aided the Society's efforts by making it lawful to confiscate the booty of offenders. The committee also notes with approbation the action of the Government of India in prohibiting the exportation of native birds' skins, except for natural history purposes. It cannot, of course, be hoped, observes the committee, that the action of a single Government will at once prevent ladies from wearing plumes in their hats, but it is nevertheless a step in the right direction. South America now appears to be one of the worst offenders in regard to bird-destruction, and it is, unfortunately, a region where there is, at present at all events, but little hope of repressive legislation being introduced. While noticing that in this country the Church has done little or nothing to aid the crusade, the report announces with satisfaction that the periodical Press has all along been on the side of the movement. "The fact of this great unfailing support, and the steady growth of this Society, inspires a hope that eventually the object which the first founders of the Society set before them thirteen years ago—namely, the suppression of this destructive fashion and trade—may be attained."

A paragraph appeared a short time ago in the *Times* recording some of the ornithological results of Mr. B. Alexander's recent expedition to Fernando Po. Mr. Alexander reached the island last December, and proceeded to explore the highlands of its northern portion, ascending Clarence Peak, which was found to be wooded to a height of between 10,000 and 11,000 feet. The novelties included in his bird-collection were described by himself at a meeting of the British Ornithologists' Club held on January 21, and are briefly described in *Bulletin* No. 44 of that body. The collection comprises nearly 400 specimens, referable to some sixty-eight species, of which no less than thirty-three are described as new. Nor is this all, for two of the species are assigned to new genera, under the names of Urolais and Poliolais. It is remarkable that the majority of the Fernando Po birds display little affinity to those of the adjacent West African lowlands, but are more nearly related to East African mountain types from Kilimanjaro and Mount Elgon. In addition to its peculiar birds, Fernando Po appears to possess a fauna and flora of great abundance and interest, the number of species of ferns at high altitudes being especially noticeable.

The Geneva correspondent of the *Daily Mail* states that Count Zeppelin has just completed an automobile-launch which possesses the peculiarity of having its propellers in the air. According to the inventor, the launch will be of the greatest use in tropical lakes and rivers encumbered with aquatic plants, which, obstructing the screw, render an ordinary steam launch useless. The launch is extremely light, has a draught of only ten inches, and it skims the water at a rate varying from fourteen to sixteen miles an hour.

We have received the first part of the new volume (vol. iii.) of the *Journal of Hygiene*, which contains several important papers. Dr. Jordan discusses the kinds of bacteria and their variation in river water. Dr. Longcope gives a study of the bacteriolytic action of human blood in disease, and Dr. Walker surveys the various factors in bacteriolytic action, from which he deduces the fact that the complement or addiment is a product of disintegration of leucocytes.

A new drug laboratory has, says the *British Medical Journal*, recently been established in the Chemical Bureau at Washington, with the object of investigating adulterations, testing drugs and establishing uniformity in the standard of medical substances for future State and national legislation. The American Pharmaceutical Association has passed resolutions approving of the new bureau.

The Glamorgan Sea Fisheries Committee, having decided to conduct an independent inquiry into the allegations respecting the pollution of Mumbles oysters, deputed Prof. Herdman to make the necessary investigations, and his report has now been published. Samples of the oysters and of the water were subjected to careful bacteriological investigation by Dr. Griffith, under Prof. Herdman's direction, and the final conclusion arrived at was that the shore, the water and the oysters all gave evidence of being polluted with sewage. Of the oysters, some were much more polluted than others.

At the meeting of the Institution of Civil Engineers on February 10, Mr. David Carnegie read a paper on the manufacture and efficiency of armour-piercing projectiles. The modern projectile is, he pointed out, composed of steel containing carbon, associated with one or more of the following metals:—nickel, chromium, manganese and molybdenum. Typical proportions per cent. of elements other than iron in shells which are air-hardened are:—carbon 0·80, silicon 0·2, sulphur 0·04, phosphorus 0·04, manganese 0·12, nickel 2·00 and chromium 2·00. In present-day methods of hardening, three mediums are used, viz. water, oil and air, and the choice of the method used is determined by the composition of the material to be hardened. Carbon steels are generally hardened in water, or partly in water and partly in oil; nickel steels in water, in oil, or in air under pressure; and steels having self-hardening properties by simply heating and allowing to cool in air.

The passage in Mr. Swinburne's presidential address to the Institution of Electrical Engineers in which he criticised the prevailing notions of the meaning and definition of the term "entropy" has given rise to an animated correspondence on the subject in the columns of the electrical and engineering papers, particularly in those of the *Electrician*. No apology is needed for directing the attention of readers of Nature to a controversy in which such distinguished men as Lord Kelvin, Sir Oliver Lodge, Prof. Poincaré and Prof. Planck have taken part, as well as the original disputants—Mr. Swinburne and Prof. Perry. The discussion does not seem to be ended yet, but we trust that when it is concluded Mr. Swinburne will not allow it to remain scattered in the columns of various journals, but will, as he himself has led us to hope, collect and republish the letters and articles. The collected statements of the views of so many authorities would be of great assistance to all students trying to grasp the full import of the second law of thermodynamics.

The paper on high temperature electrochemistry read by Messrs. R. S. Hutton and J. E. Petavel before the Manchester Section of the Institution of Electrical Engineers last November contains a most interesting and suggestive account of electric furnace work. The paper is divided into two parts, the first of which deals with the equipment of an experimental electrometallurgical laboratory. A description of the apparatus available at Owens College is given; the authors are certainly to be congratulated on having the opportunity of working in a laboratory so well equipped as this. Amongst other special apparatus may be noted a furnace capable of working with currents up to 1000 amperes under pressures up to 200 atmospheres. This furnace, which has been provided out of funds from the Government Grant Committee of the Royal Society, is intended to be used for research on the effect of gaseous pressure on high temperature chemical reactions. The second part of the paper consists of notes on technical processes, and in it the authors direct attention to the more important features of the various electric furnace processes in commercial operation at the present time.

Modern tendencies in the utilisation of power formed the subject of the address given by Prof. J. J. Flather to the Engineering and Mechanical Science Section of the American Association for the Advancement of Science. In the first part of the address the question of the distribution of power in workshops is considered, and the author deals at some length with the relative merits of electricity, compressed air and hydraulic pressure under various conditions. In the latter part of the paper Prof. Flather deals with some of the larger questions of power generation and transmission. He points out that the competition between oil, gas and steam engines, and steam turbines is likely to lead to the further development and perfecting of each for the purposes for which it is specially suitable. The paper contains some interesting data showing what has already been accomplished in the way of generating power by large gas engines and steam turbines.

The November issue of the *Proceedings* of the Philadelphia Academy contains an important paper, by Mr. W. H. Dall, on the American representatives of the bivalve group, Carditaceæ.

In the February number of the *Irish Naturalist* Prof. G. Wilson gives additional information with regard to the proposed marine laboratory for Ulster, to which allusion was made in the January issue of that journal. All concerned are agreed as to the need of such an institution, especially in connection with the Irish sea-fisheries, and the one difficulty in the way is the acquisition of the necessary funds.

A notable addition to the British (Natural History) Museum is a fine specimen—skin and skeleton—of the great Indian rhinoceros (*Rhinoceros unicornis*), presented by H.H. the Maharajah of Kuch-Behar. The mounted skin is placed for the present in the entrance hall.

Our German contemporary, *Naturwissenschaftliche Wochenschrift*, contains an illustrated article, by Dr. M. von Linden, on Eimer's theory of the evolution of colour-markings in animals. On this theory, it will be remembered, longitudinal striping is regarded as the first stage; from this spots are developed by a breaking-up process, and these again may coalesce to form vertical stripes.

Some weeks ago we noticed an article, by Prof. C. H. Eigenmann, on the development of American eels, in which attention was called to the practice of giving separate specific names to the larval "leptocephali." We have just received two papers on the life-history of American eels, issued in 1901 by the U.S. Fish and Fishery Commission, one by Mr. Eigenmann and the other by Messrs. Eigenmann and Kennedy. In the second of these it is confessed that the practice of naming leptocephali is an anachronism, although it is considered permissible in cases where the adult form cannot be identified.

Dr. Camillo Bosco contributes to the *Atti dei Lincei*, xi. 12, a study of the cranium of a beaver of the Quaternary period, found in the gravels of Maspino, near Arezzo, and

now in the palæontological museum at Florence. This skull was referred by Forsyth Major and Rütimeyer to *Castor fiber*. It is much more closely related to the European than to the Canadian beaver, particularly in the shape of the nasal parts, the zygomatic arches, the breadth of the frontal and nasal regions, and the parietal crests; it differs, however, from both forms in the palate, which is much broader behind than before, the incisors, which are broader, and the molars, which decrease rapidly in size from the first to the last, and on the surface of which the folds of enamel are slightly sinuous. At the same time, the fact that the nasal bones have retained the same form and breadth during the geological intervals which have elapsed from the time of the Maspino beaver and the Pliocene specimen of Valdarno Superiore affords an argument in favour of the specific separation of *Castor fiber*, L., from *C. canadensis*, Kuhl.

M. L. Houllevigue describes in the *Journal de Physique* for January some interesting results obtained by depositing thin films of metal on glass and other surfaces by kathodic rays in a bell glass receiver. With deposits of palladium the moisture of the breath was sufficient to break up the film, and the same was to a less degree the case with platinum. In the case of copper, crystals of oxide commenced to form at the edges, and soon extended inwards, but the process was arrested before reaching the middle part, which was the thinnest portion of the pellicule. An attempt was made, extending over seven days, to obtain a carbon film, but the only deposit obtained was probably due to the copper of the support. The electric resistance of a film of bismuth obtained by projection was found to be insensible to a magnetic field. On the other hand, transparent laminæ of iron, placed normally to the field of a Ruhmkorff coil, afforded a ready illustration of magneto-optic rotation. In connection with this work, M. Ed. van Aubel calls attention to the investigations of Wright, Kundt, Patterson and J. J. Thomson.

"Factorisation of large numbers" is the subject of a paper read by Mr. F. J. Vaes, of Rotterdam, to the Amsterdam Academy of Sciences last year. The method which forms the starting-point of Mr. Vaes's paper consists in the expression of the given number as the difference of two squares. Taking, say, the number 513667, the next greater square is 717^2, and he writes $513667=717^2-422$. Then he increases the first and second terms of the difference in succession by $2.717+1$, $2.717+3$ . . ., that is, 1435, 1437, 1439 . . .; the results are thus 718^2-1857, 719^2-3294 . . . and when the second term is a perfect square, the factorisation will be completed. However, the work may be shortened by observing that a perfect square cannot end in 2, 3, 7 or 8, and further, the author gives a table of all the groups of four figures in which a square can end, by which further abbreviation appears possible. It is obvious that the process stops when the original number $2n+1$ is expressed in the form $(n+1)^2-n^2$, and if a square has not been obtained previously, the number will be known to be prime.

Referring to Dr. E. H. Barton's letter, published in our last issue, describing a simple sensitive flame, Prof. W. F. Barrett, F.R.S., directs attention to a lecture delivered by him before the Royal Dublin Society on January 3, 1868, in which he thinks he used such a flame to demonstrate the reflection and refraction of sound.

The short nature-studies written by Prof. L. C. Miall, F.R.S., and published under the title "The History of Aquatic Insects" by Messrs. Macmillan and Co., Ltd., in 1895, have been issued in a cheaper form at 3*s*. 6*d*. Advantage has been taken of the reissue to make a few emendations and additions. In its new form the book will doubtless secure a wide popularity in the classes for nature-study which are being instituted in many parts of the country.

Messrs. George Bell and Sons have published separately, at 2*s*. net, under the title "Webster's Pictorial Dictionary," the three thousand or more illustrations in "Webster's International Dictionary of the English Language." The pictures have been classified and arranged according to subjects. As was, perhaps, to have been expected, a very large proportion of the figures illustrate scientific subjects, and exceptional prominence seems to have been given to botanical and zoological terms.

A second edition of "An Elementary Course of Infinitesimal Calculus," by Prof. Horace Lamb, F.R.S., has been issued by the Cambridge University Press. The book was first published in 1897, and a review of it appeared in Nature for July 28, 1898. In the new edition the book has been carefully revised, and several errors have been corrected, principally in the examples. A few paragraphs in the latter portion of the book, relating to infinite series, have been amplified.

The seventh volume of *The South-eastern Naturalist*, being the *Transactions* of the South-eastern Union of Scientific Societies for 1902, has been received. Amongst other interesting contents, the volume contains the presidential address, by Dr. Jonathan Hutchinson, F.R.S., on leprosy in the Middle Ages, and the following papers:—Miss A. L. Smith, on mycorhiza, the root-fungus; Mr. E. R. Harrison, on eolithic flint implements; Prof. G. S. Boulger, on the preservation of our indigenous flora; Mr. E. A. Martin, on the protection of plants; Mr. Sibert Saunders, on the marine aquarium, without circulation or change of water; and Mr. W. Whitaker, F.R.S., on Kentish wells and deep borings in the neighbourhood of Canterbury. The report of this union of scientific societies, with which the publication begins, is of a highly satisfactory character, and the record of the work accomplished, or now being done, by members of the affiliated societies shows a very creditable activity on the part of the union.

The International Oxy-Generator Syndicate, Ltd., has submitted to us for examination a simple and convenient form of apparatus for the manufacture of oxygen, known as the "'Ever Ready' Portable Automatic Oxygen Generator." The apparatus consists of a steel tube used as a retort, a spirit lamp for heating the retort, a purifying tank for washing and cooling the gas, an automatic travelling stage, a collapsible gas holder for storing the gas, and all the necessary connections. The whole of the parts pack easily into a case of moderate size, and there are no complications to get out of order or to puzzle the novice. The oxygen is obtained in the usual manner by heating a mixture of potassium chlorate and manganese dioxide. As a means of avoiding the difficulties of procuring cylinders of compressed oxygen in out-of-the-way places, this generator should prove very useful.

In the *Proceedings* of the American Academy of Arts and Sciences, vol. xxxviii. No. 5, T. W. Richards has published a simple method of gas-analysis which requires only the simplest apparatus and yet is capable of yielding results accurate enough for many ordinary purposes. The actual measurement consists in a determination of the pressure, the volume of the gas being kept constant. As an elementary exercise for students, the use

of such a simple apparatus possesses many advantages over the ordinary gas apparatus employed in practice.

THE epidiascope, a new optical lantern, which we have examined at the London branch of Mr. Carl Zeiss, of Jena, is primarily intended for the projection on the screen of opaque bodies, such as insects, coins, fossils, diagrams, &c., in their natural colours. It is equally serviceable for projection of transparent objects, *e.g.* lantern slides, and microscopic preparations can likewise be shown with considerable magnification. The source of light is an arc-lamp of 30 or 50 amperes, at the focus of a parabolic reflector; the light is either thrown upon, or transmitted through, the object by a system of condensers and mirrors. The images are brilliant and well-defined. In its primary capacity the lantern gives remarkably interesting results, the images, for instance, of butterflies or coins being most realistic in appearance, owing, no doubt, to the fact that the shadows of the objects viewed are reproduced just as in nature. Dark heat rays are trapped by a water tank, so that delicate biological specimens, and even living organisms, may be depicted on the screen. A notable feature of the instrument is its convenience in manipulation, the change from opaque to transparent bodies taking but a few seconds. The object chamber is large, and objects are laid on a horizontal table without clamping. Manuscripts and pictures so large as 8½ inches square can be shown, hence the instrument should be useful, not only to men of science, but for class lectures and educational purposes.

WE have received the *Proceedings* of the University of Durham Philosophical Society, vol. ii. part ii. Amongst other papers is an interesting communication by Prof. P. P. Bedson on the gases enclosed in coal. The gases enclosed in the various samples of coal or coal dust were obtained by heating weighed quantities of these in tubes connected to a Sprengel pump and heated usually to 100° C. by means of boiling water. In addition to marsh gas, carbon dioxide, oxygen and nitrogen, evidence has been obtained of the occurrence of the higher hydrocarbons ethane and propane. These latter are not evolved so readily at 100° C. *in vacuo* as marsh gas, and a partial separation of the hydrocarbons can be effected on the basis of this property. Another point of interest in the paper is the experimentally established fact that coal, after removal from the mine, not only gives off some of its "enclosed gases," but takes up the gases of the atmosphere and the oxygen more readily than the nitrogen.

THE annual report for 1901 of the Smithsonian Institution at Washington has reached us. Although many details of interest are described in Prof. Langley's report, most readers will turn with the greatest pleasure to the valuable appendix of nearly 600 pages. This appendix is a summary of the most interesting scientific work of the preceding year, presented in a form which will appeal, not to men of science alone, but to the intelligent general reader. It contains fifty articles by men of science of many nationalities, most of them profusely and excellently illustrated. The first article gives a short sketch of the history and work of the Smithsonian Institution, and this is followed by one by Mr. Abbot on some recent astronomical events. Prof. Rücker's presidential address to the British Association at Glasgow is reprinted, as well as a number of Royal Institution lectures. Among these are that of Prof. Poynting on recent studies in gravitation, Prof. Dewar's on solid hydrogen, Mr. Marconi's on wireless telegraphy and Dr. Glazebrook's on the aims of the National Physical Laboratory. Numerous other interesting contributions include that by Lord Kelvin on ether and gravitational matter through infinite space, one by Prof. J. J. Thomson on bodies smaller than atoms, and several by Prof. S. P. Langley—that which appeared first in NATURE, on "The Fire Walk Ceremony in Tahiti," is one of them; while another shows the comparative efficiency as flying machines of various large birds and artificial aërodromes. There are also papers on the utilisation of the sun's energy, the Bogoslof volcanoes of Alaska, forest destruction, irrigation, pictures by prehistoric cave-dwellers in France, and one on the National Zoological Park at Washington by Mr. Seton Thompson. Several beautiful coloured plates add to the attractiveness of the volume.

THE additions to the Zoological Society's Gardens during the past week include two Coquerel's Mouse Lemurs (*Chirogaleus coquereli*) from Madagascar, a Mohr Gazelle (*Gazella mohr*) from North Africa, two Gould's Monitors (*Varanus gouldi*), six Bearded Lizards (*Amphibolurus barbatus*) from Australia, a Tamandua Anteater (*Tamandua tetradactyla*) from South America, deposited; a Common Stoat (*Mustela erminea*), European, purchased.

CORRECTION.—In line nine from the end of Mr. G. W. Butler's letter in NATURE of February 12 (p. 344), omit the word *of*.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMET 1903 *a*.—M. P. Chofardet, of the Besançon Observatory, records in the *Comptes rendus* for January 26 that on January 21 the apparent diameter of this comet was 1'·5 and its magnitude was about 10–11; a small eccentric condensation towards the south was also observed. On January 24 the condensation was central, and a small stellar nucleus was seen.

DETERMINATIONS OF STELLAR RADIAL VELOCITIES.—As a supplement to a previous note on the determinations of the radial velocities of the planets made at Meudon, M. Deslandres contributes to No. 4 (1903) of the *Comptes rendus* the results of the determinations of the radial velocities of θ Aquilæ, ϕ Persei and ψ Persei, and he also describes the spectrograph with which they were determined, together with the sources of error to which the determinations are subject.

In the case of θ Aquilæ (a white star of Pickering's class VII*a*.), where the hydrogen lines are broad and the metallic lines fine, the magnesium line λ 4481 was used. The results show a considerable variation in the velocity, and a mean period of about seventeen days with a shorter period of three days superimposed; the star is a spectroscopic binary.

The star ϕ Persei has bright hydrogen lines which show central reversals, and the fine dark reversals have been used in determining the velocity, which is variable.

In ψ Persei, the hydrogen lines are bright and superimposed on very broad dark lines, and each shows several dark reversals some distance apart, exactly similar in appearance to those seen in Nova Persei and other temporary stars.

For the comparison spectrum in each case, a spark from poles containing iron and titanium was used.

THE COLOUR OF THE ECLIPSED MOON.—In a description of the phenomena observed during the lunar eclipse of October 16, 1902 (*Astronomische Nachrichten*, No. 3845), Prof. E. E. Barnard comments on the various colours assumed by the eclipsed moon at different eclipses. He says that the appearance of the lunar surface during the last eclipse was by far the darkest he has yet observed, being of a dull coppery red colour, whilst that of June 11, 1881, was a beautiful bright cherry red, and suggests that this variation is probably due to the differences existing in the terrestrial atmospheric conditions during the various eclipses.

Prof. Barnard further remarks that the dark coloration is not evenly distributed during an eclipse, for in the present case he observed a dark smear running from east to west across the eclipsed moon, and he suggests that this phenomenon was probably due to some local disturbance in our atmosphere at the time of the eclipse.

SOLAR PROMINENCES AND TERRESTRIAL MAGNETISM.

SINCE the year 1871 the Italian astronomer, Prof. Tacchini, has been daily making spectroscopic observations of the sun, noting the number, size and position of the prominences visible on the solar limb. A preliminary study of this very valuable homogeneous series of data rendered it possible to demonstrate that the variation of the frequency of occurrence of these phenomena followed a very general law, the number waxing and waning at intervals of about eleven years, and synchronising with the variation of the number of spots on the sun's disc. This result was pointed out some time ago in the pages of this Journal (vol. lxvi. p. 248), and it was there further stated that there were in addition subsidiary maxima and minima superimposed on the main eleven-year curve.

This preliminary study dealt with the prominences visible on the sun's limb *in toto*, and did not consider their frequency in any particular part of it.

A subsequent analysis indicated, however, that by taking the solar limb to pieces, so to speak, and dealing with the individual parts of it, very interesting results might accrue. This work has recently been completed, and it was found that the frequency of prominences varied according to the particular solar latitude examined, and that the phenomena of terrestrial magnetism were very closely connected with these variations.

In a recent communication to the Royal Society[1] the comparison of these two classes of phenomena, as mentioned above, has been made in some detail, and the present article gives a brief account of the conclusions derived from the inquiry.

For the reduction of the prominence observations the limb of the sun was divided into parts ten degrees in length, corresponding with ten-degree zones of solar latitude north and south, and each zone was examined and discussed by itself. Further, the observations for every three months were, in the first instance, grouped together, and the percentage frequency for each of these periods was determined individually.

In this way a set of eighteen curves, nine for each hemisphere, was made, showing the variation from year to year of the percentage frequency of prominence activity in each ten-degree zone.

In the curves accompanying the present article (Fig. 1) the above-mentioned set, except those for 80°–90° north and south, was grouped in pairs, thus representing the percentage frequency of prominences in each hemisphere for zones of 20° of latitude, 0°–20°, 20°–40°, &c., since it was found that this reduction could be made without losing any of the characteristic variations.

An examination of these curves shows that they differ very considerably one from the other as we proceed from the equatorial to the polar zones. Generally speaking, the curves representing the variations for each of the zones, 0°–20° north and south, conform with the sun-spot curve; that is, the maxima and minima occur at about the epochs of sun-spot maxima and minima. Those for the two zones 20°–40°, in both hemispheres, conform also in the main to the general sun-spot curve, but in addition they display subsidiary maxima or changes of curvature superimposed on the main curve.

The curves for the two zones, 40°–60° north and south, have, on the other hand, hardly any likeness to the sun-spot curve, but are made up of a series of prominent maxima representing special outbursts of prominence activity.

Passing to the curves corresponding to the next zones, *i.e.* 60°–80° north and south, these indicate two prominent outbursts lasting for a short period, showing that this region of the sun is, as a rule, practically free from prominence activity; in the remaining zones, 80°–90° north and south, the variation is small, and is a faint echo of the condition of affairs in the neighbouring zone 60°–80°.

The data regarding the magnetic phenomena which were employed were those brought together by Mr. William

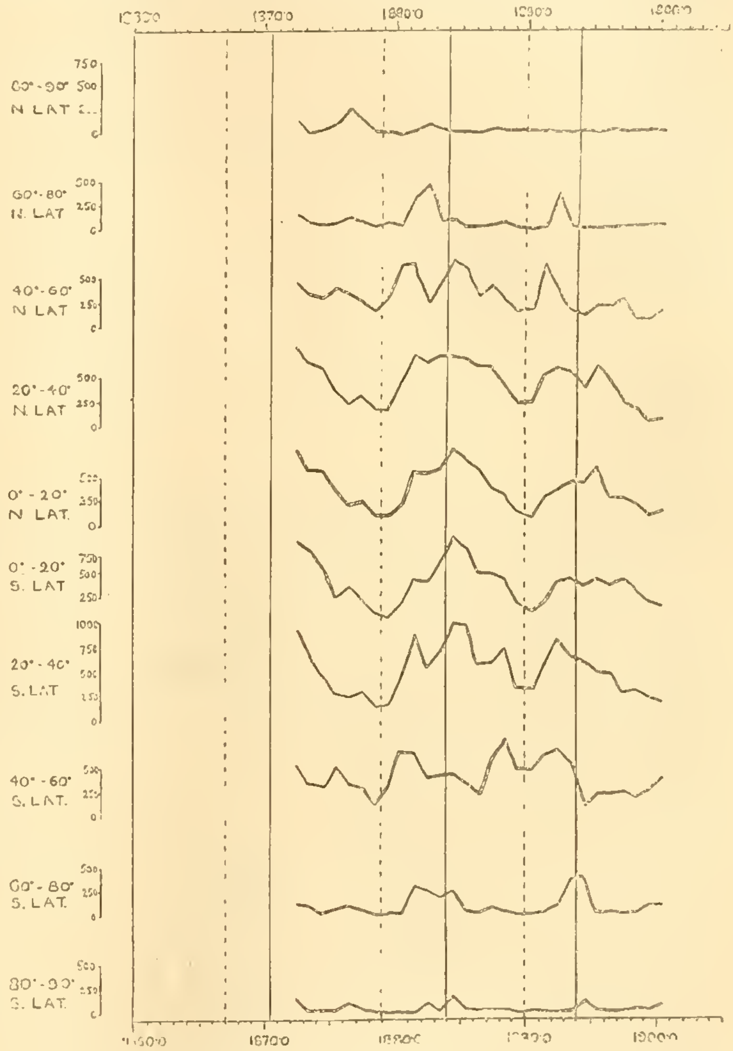

FIG. 1.—Curves showing the percentage frequency of solar prominences for each 20 zone N. and S. (The continuous and broken vertical lines indicate the epochs of sun-spot maxima and minima respectively.)

Ellis, who very kindly brought the whole of them up to date for the purposes of the present inquiry.

Two classes of magnetic phenomena were dealt with, namely, the variations from year to year of the diurnal range of the declination and horizontal force, and magnetic disturbances. As regards the former, Mr. Ellis has shown that the curves indicating these variations are very similar to that of the general sun-spot curve; in fact, the curves were found to be almost identical in all their smaller irregularities. The second class of phenomena, namely, the magnetic disturbances, which are more irregular in occurrence, has been classified by Mr. Ellis into five groups, and tabulated by him

[1] "The Relation between Solar Prominences and Terrestrial Magnetism." By Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Received January 14, read January 29, 1903.)

under five separate subheads. In this investigation only that class described as "great" has been used, since this group represented the largest disturbances.

Mr. Ellis, as already has been pointed out, has indicated the close resemblance between the sun-spot curve and that representing the variation of the magnetic elements; and

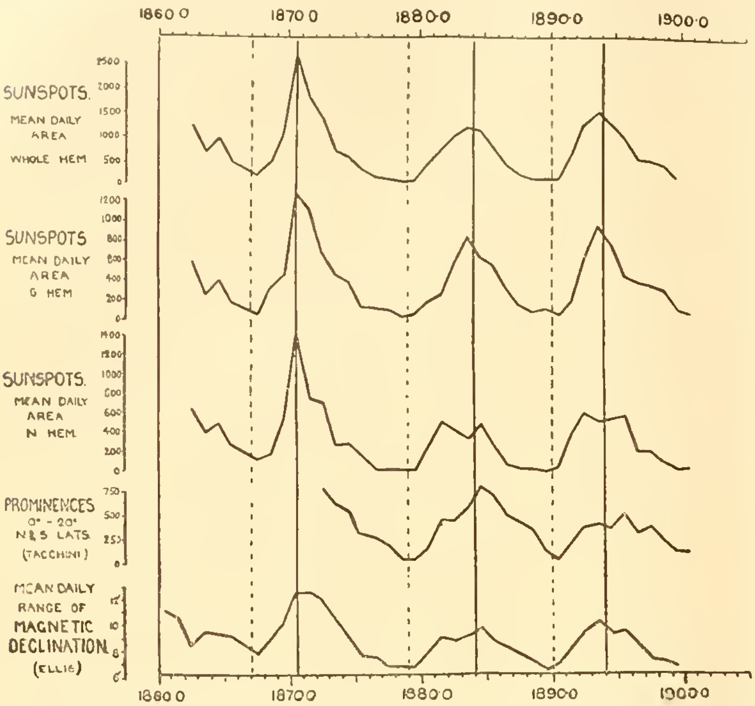

FIG. 2.—Comparison of curves representing variations of magnetic declination, solar prominences (0°–20° N. and S.), and sun-spot areas. (Continuous and broken vertical lines as in Fig. 1.)

it has also been shown that the curves representing the percentage frequency of prominences near the solar equator conform in the main to the general sun-spot curve.

There is, therefore, an apparent connection between phenomena occurring in the equatorial regions of the sun, the percentage frequency of prominences near the solar equator, sun-spots (which are practically restricted to these zones), and the ordinary diurnal magnetic variation.

The accompanying set of curves (Fig. 2) illustrates the great similarity between those showing the frequency of prominences in a zone about the equator (0°–20° north and south) and the variations of the mean daily range of magnetic declination; for the sake of comparison, three other curves are added, showing the variation of the mean daily area of the sun-spots for the whole, and the two hemispheres of the sun separately.[1]

Leaving the variation of the diurnal range of the magnetic elements and turning our attention to the magnetic disturbances, it will be seen that if a comparison of the curve representing the number of days of the "great" disturbances be made with those representing prominence frequency (Fig. 1), the former is as unlike the curves representing the prominence frequency about the solar equator as it is like those near the poles; in fact, the polar prominence outbursts and great magnetic disturbances occur almost simultaneously.

The peculiar form and general similarity of the curves can be best seen from the accompanying illustration (Fig. 3). In the figure comparison is made between the epochs of the crossing of the known and unknown lines observed in sun-spot spectra, the percentage frequency of prominences about the solar poles and Ellis's "great" magnetic disturbances.

Two curves representative of prominence frequency are given, one to indicate the abrupt nature of the curves representing the frequency in a zone near the pole 10 degrees in width (in this case 60°–70° north), and the second to illustrate polar action as a whole; this latter was obtained by making a summation of prominence frequency for the two zones 60°–90° north and south.

The simultaneous occurrence of the maxima suggests that, when the prominence action takes place at the polar regions of the sun, one effect on the earth is that we experience our greatest magnetic disturbances.

Mr. Ellis has previously stated that unusual magnetic disturbance is frequent *about* epochs of sun-spot maximum. The present inquiry indicates that not only do these "great" disturbances occur at the same time as the *polar* prominences, but the spectroscopic observations of sun-spots show that they take place not only "about" the times of spot maximum, as stated by Mr. Ellis, but when the sun-spot curve is *approaching* a maximum and at the dates of the widened line crossings, when the curve representing the "unknown" lines is on the rise, and crosses the "known" line which is descending. At the other epoch of "crossing," *i.e.* when the

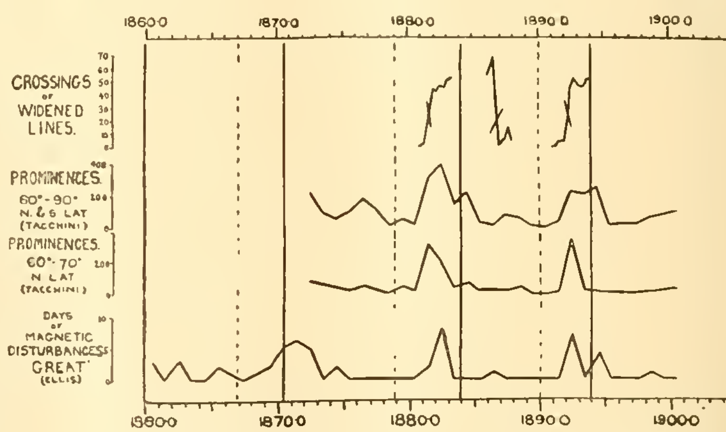

FIG. 3.—Comparison showing days of "great" magnetic disturbance, polar prominences, and crossings of widened lines. (The continuous and broken vertical lines as in Fig. 1.)

curve showing the "known" lines is on the rise and the "unknown" is falling, there is practically no "great" magnetic disturbance recorded.

[1] In referring to the curve representing the variation of the mean daily areas of sun-spots, it may be noted that this is obtained by combining the mean daily areas of both hemispheres of the sun. A closer analysis shows, however, that this variation is not the same for both hemispheres. From the year 1862, when such a division of the sun's disc can be easily investigated, the northern hemisphere, about the time of the two last maxima, displayed double maxima occurring in the years 1881 and 1884, and in the years 1892 and 1895. About the time of the maximum of 1870 this duplicity is not so marked, although when compared with the curve for the southern hemisphere for this period, there is a slight indication of a subsidiary crest in 1872. In the case of the curve representing the mean spotted area for the southern hemisphere alone, at all the three epochs of maximum, the curves are single-crested and indicate sharply-defined maxima in the years 1870, 1883 and 1893.

From the above it will be seen, therefore, that the actual epochs of sun-spot maxima, as determined from the northern and southern hemispheres respectively, are not the same, and in dealing with the curve representing this variation for the whole hemisphere, this fact should be borne in mind. It may further be noted that the epochs of minima may be practically considered the same for both hemispheres.

This apparently close connection between solar prominences and magnetic storms perhaps explains why it is that the latter sometimes take place when there are no spots, or no very large spots on the solar surface. Thus, for instance, there may be prominences and magnetic storms when there are no spots; prominences may also sometimes be associated with large spots, and as the latter can be seen while the former cannot, the resulting magnetic storm is generally attributed to the spots.

Further, the magnitude of magnetic storms appears to vary according to the particular position as to latitude of the prominence on the sun's disc. The nearer the poles (either north or south) the prominence occurs, and these are the regions where no spots exist, the greater the magnetic storm.

In conclusion, it may be stated that the inquiry has shown that the variations of the general magnetic phenomena, as given by Ellis, synchronise with the occurrence of prominences about the solar equator, while his "great" magnetic disturbances occur, in point of time, with the appearance of prominences in the polar regions of the sun. Prof. Bigelow has recently (U.S. *Monthly Weather Review*, July, 1902, p. 352) investigated the variations in the horizontal magnetic force, and finds that the curve representing these changes exhibits subsidiary maxima which synchronise with those recorded in the curve representing the mean variation of prominences for all latitudes. Thus, to use his own words, "the remarkable synchronism between the curves cannot escape recognition, except after the year 1894, when an extra minor crest is developed in the horizontal force."

WILLIAM J. S. LOCKYER.

THE FORTRESS OF THE MOLE.

FOR the last three-quarters of a century, at any rate, natural history writers have been content to copy a diagrammatic figure of the breeding-hillock of the mole, without the least attempt to ascertain for themselves to what extent it is based on actual fact. The diagram in question was based on a fairly authentic account of the mole's habits drawn up by de Vaux just a century ago, but was elaborated by G. St. Hilaire and further "improved" by Blasius. Recently, Mr. L. E. Adams, whose special study is the Mollusca, has examined a large series of mole-hillocks in Staffordshire and has found that in no case does the structure of the one in which the nest is formed correspond with the current diagram of the so-called "fortress." His account, illustrated with numerous diagrams (two of which we are enabled to reproduce) is published in vol. xlvii., No. 4, of the *Memoirs* of the Manchester Literary and Philosophical Society. It shows that in certain other respects our ideas of the life-history of the mole require modification.

With regard to the situation of the breeding-hillock, or fortress, as it still may be conveniently called, Mr. Adams finds that this is generally in the open field, although it may occasionally be placed in a hedge-bank, but only when there is a ditch alongside. Indeed, the proximity of water seems to be the main factor in determining the position of the structure. Now and then a fortress may be found under a tree, but it is considered by the author that such a position is probably accidental.

According to the old idea, it was supposed that the runs with which it is permeated were made on a certain definite plan, allowing of free escape from the invasions of foes both above and below ground. This idea receives no support from the new observations, which tend to show that the more or less complicated galleries are purely incidental, and, with the exception of one "bolt-hole," have no reference to premeditated escape. In place, indeed, of being examples of a wonderful instinct of self-preservation on the part of their constructor, it appears that the galleries of the fortress are the natural, incidental and inevitable outcome of the work of excavating the nest-cavity and piling up the superincumbent mound.

When the site for the fortress has been fixed, a circular cavity is excavated for the reception of the nest at a depth of from two to six inches below the surface of the ground, except in the case of boggy soil or in situations liable to be flooded, when the nest is often made above the original ground-level. The easiest way to dispose of the excavated soil is to push it up to the surface, and for this purpose a tunnel is constructed, and in such a case the whole mound is made by this tunnel.

"When this superincumbent earth," writes the author, "has reached an inconvenient height, another tunnel is made, sometimes from another part of the nest-cavity (Fig. 1, *a*, *b*), but more often sideways from the first upward tunnel. All this takes time, and the mole meanwhile makes fresh runs from the fortress, the seat of its labour, in various directions in search of food. Much of the earth displaced in making these fresh runs falls into the nest-cavity, and has to be disposed of in the same way as before, and also the soil displaced in making the bolt-run and the down-shaft, when this latter occurs. Now the tunnel (or tunnels) leading upwards from the nest-cavity becomes larger and larger, winding round under the surface of the growing fortress. When this removal of earth becomes too fatiguing, on account of the length of the tunnel, the mole will often begin to make new tunnels from runs close to the end of the fortress. Sometimes these new runs break into those leading from the nest-cavity, but not very often; usually they lie above them."

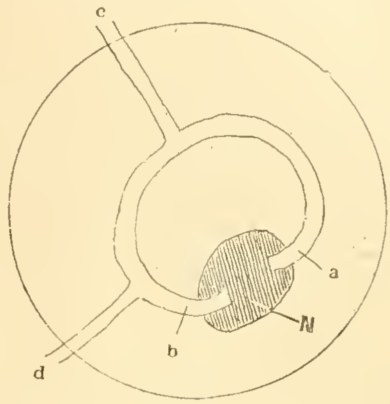

FIG. 1.—Plan of a simple mole fortress, from above. *a*, *b*, excavation tunnels; *c*, *d*, tunnels made for forming protecting heap; N, nest.

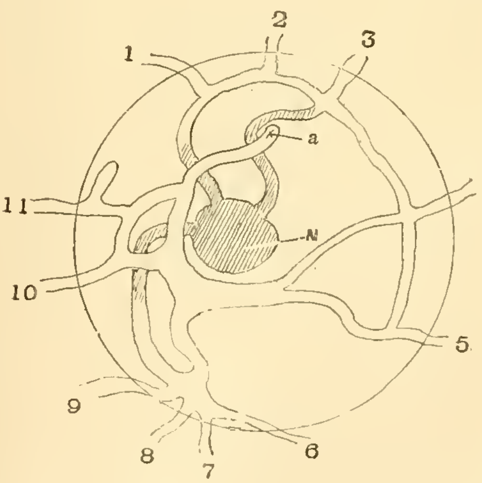

FIG. 2.—A complicated mole-fortress with eleven exits. *a*, apex of the tunnels; N, nest.

It thus appears that the tunnels are for two distinct purposes. First, we have those formed for ejecting earth from the nest-cavity and bolt-run, which are generally in the shape of a corkscrew ascending from the nest, and often with blind divergent terminations. And, secondly, tunnels

unconnected with the nest-cavity, but traversing the fortress from external runs, through which earth has been carried to heap over the nest. Fig. 2 shows a fortress of the most complicated type.

Except when in marshy soil, nearly every fortress has the aforesaid bolt-run, which leads upwards from the bottom of the nest, and thus outwards, without connection with the other tunnels. More rarely a down-shaft, which may be nearly a yard in length, descends obliquely from the nest. The use of these down-shafts is not apparent. Presumably it is in them that the collections of paralysed worms, supposed to be stored up by the mole as food, have been found. Such collections of worms are, however, regarded by the author as accidental.

The nest-cavity, which is about the size of a large cottage-loaf, and worn smooth by friction, contains a ball of grass or leaves, or a mixture of both, by which it is completely filled. In the case of the English species, at any rate, no fur from the mole's body is used in lining the nest. Apparently a nest is never used for more than one season, but two or even three nests, generally one above the other, may be found in the same fortress, of which the newest is alone in use. In all cases it appears that the female makes a fortress and nest of her own in which to breed, this being usually less complex than that of her partner, and without a bolt-run. Whether previous to the breeding-time the female inhabits the same fortress as the male is doubtful, and it is not improbable that moles are polyandrous.

It is now demonstrated that the female produces only a single litter annually. The young are usually born between the middle of April and the latter part of June, after a gestation of four weeks; the number in a litter varies from two to six, three or four being usual. The number of teats in the female is eight, and not, as usually stated, six. R. L.

THE VISIBILITY OF ULTRA-MICROSCOPIC PARTICLES.[1]

IN the course of an optical investigation of various shades of ruby glass, Messrs. Siedentopf and Zsigmondy devised a method of observing small particles of gold which closely approach molecular dimensions, and thus extending our range of molecular vision very considerably.

The ruby glasses, examined by the best ordinary microscopes, appeared perfectly homogeneous. But the authors reasoned that if the gold particles embedded in the glass were at such distances apart that a microscope could resolve them, they could be made visible even though their size should be a small fraction of the wave-length of visible light. The only condition was that the product of the specific intensity into the surface of the luminous particles and the square of the sine of the effective angle of illumination should be greater than the inferior limit of the sensitiveness of the human eye. The problem is thus reduced to that of the visibility of a fixed star. What is seen is, of course, a diffraction disc, and that is all we can hope to see, but the authors indicate a means of determining the true size and weight of the particles seen.

It is essential that all disturbing side-lights should be avoided. The authors threw a beam of sunlight through a condenser on a slit 0.05 to 0.5 mm. wide, and an image of the slit was produced in the field of vision by a telescope lens and a collimator with a reduction of 36 diameters. The diffraction discs seen in the ruby glass had an average apparent diameter of 1 mm., while their real diameter, calculated from the quantity of gold present and the number of particles counted in unit volume, was 0.02 μ on the average. This gives a magnification of 50,000 diameters. The utmost limit to which the magnification can be pushed by this method is about 150,000 diameters, or 6 $\mu\mu$. The average diameter of a molecule being 0.6 $\mu\mu$., it cannot be seen, even as a diffraction disc, unless its specific luminosity were ten times that of the solar molecules, or the sensitiveness of the eye were greatly increased. The cumulative effects used in photography may be resorted to, but the authors do not mention that possibility.

[1] Abstract of a paper by H. Siedentopf and R. Zsigmondy (*Annalen der Physik*, No. 1, 1903, pp. 1–39).

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A meeting of the teachers of natural science was held in the examination schools last Saturday to hear the views of a deputation of the Association of Public School Science Masters on the subject of entrance scholarship examinations. It was agreed that two principal subjects should be offered in scholarship examinations, and a suggestion was made that the subjects should be selected from physics, chemistry, botany, zoology and geology. The meeting was divided in opinion as to whether botany and zoology should form one group or two. With regard to the recommendation of the deputation that candidates not offering chemistry and physics should be given an elementary paper in these subjects, the meeting was unanimous as to the desirability of this course, and further suggested the addition for those candidates of a practical examination in elementary chemistry and physics, which should not be confined to qualitative analysis.

CAMBRIDGE.—At a conference held on February 7 between representatives of the Association of Public School Science Masters and the college tutors in natural science, the following recommendations in regard to the college examinations for entrance scholarships and exhibitions were provisionally agreed to:—(1) That the science part of the examination should consist of: (1) Papers and practical work in not more than six subjects, namely, (1) physics, (2) chemistry, (3) geology, (4) the natural history of plants, (5) zoology, (6) the elements of botany and zoology, it being understood that no candidate may take the subject (6) if he take either of the subjects (4) or (5). Of these six subjects candidates must offer not more than two. (2) Candidates who take subjects (3), (4), (5) or (6) should be required to take an elementary paper in physics and chemistry. (3) Candidates who take subject (1) should be required to take an elementary paper in mathematics.

The vacancy at Caius College, caused by the death of Dr. N. M. Ferrers, F.R.S., has been filled by the election of the Rev. E. S. Roberts, senior tutor to the mastership.

The Gilbey lecturer in agriculture will give this term a course of lectures on small holdings and allotments in the Chemical Theatre, on Fridays, at 5.

A REPORT of the Committee of Privy Council in favour of the petitions of the Liverpool University College and Owens College, Manchester, for charters of incorporation as independent universities, was submitted to the King in Council on Monday and approved by him. The decision will be received with pleasure by all who are interested in the development of higher education in this country. It is essential that we should have more universities if we are to march with the times. Regional universities are not known in any civilised country, and only end in examinations and the destruction of real teaching and research. In the report published in Tuesday's *Times*, the committee expresses the opinion that as the step involves issues of great moment, and as the effect of the multiplication of universities ought not to be lost sight of, the authorities of the Yorkshire College at Leeds should have the opportunity of submitting a draft charter incorporating a University in Yorkshire before the draft charters sought are finally settled, and that the institutions concerned should be invited to consider in greater detail not only the points on which joint action is desirable, but also the methods by which it can best be secured. The committee also considers that special rights of inspection should be reserved to the King as Visitor, and that careful provision should be made in the charters to secure an effective voice to external and independent examiners in all examinations for degrees.

DR. D. J. CUNNINGHAM, F.R.S., professor of anatomy in Dublin University, has been unanimously elected to succeed Sir William Turner in the chair of anatomy at Edinburgh.

REUTER reports that it has been decided to create a chair of commercial science, with a special faculty, in the University of Zurich, which is the first on the continent to establish such a chair.

The Duke of Devonshire will lay the foundation stone of the new technical institute and public library for Eastbourne on Saturday, April 25. The Duke has presented a site valued at 10,000*l*.

Dr. Arthur Dendy has resigned the chair of biology in the Canterbury College (Christchurch, New Zealand), in order to go to the Cape of Good Hope as professor of zoology in the South African College, Cape Town, Cape Colony.

As an instance of the thorough manner in which educational problems are taken up in America, an announcement made by the Lahore correspondent of the *Pioneer Mail* is interesting. It appears that the University of Chicago has commissioned Mr. Alleyne Ireland to make a tour of the European dependencies in the East with a view to deliver a series of lectures on "Management of Tropical Colonies." He has already visited Hong Kong, Borneo, Singapore, and is now in India, though only as a tourist. He is devoting his attention for the present to European dependencies in Asia other than India.

At the last monthly meeting of the Pharmaceutical Society of Ireland, the following resolution was adopted:—That, in connection with the appointment of teachers of chemistry under the Department of Agriculture and Technical Instruction, the council take steps to ascertain the requirements of the Department, with the view of having their certificates accepted as qualifying their licentiates for the appointments. This resolution may lead to a modification of the course of instruction in the Irish Pharmaceutical Society's School of Chemistry which will make it possible for the licentiates of the school to qualify as teachers of chemistry in the Irish intermediate schools.

Reference to the Education Bill for London was made in the King's speech delivered by His Majesty at the opening of the new Session of Parliament on Tuesday. The words used in the speech to the Commons were:—"Proposals will be submitted to you for completing the scheme of educational reform passed last Session by extending and adapting it to the metropolitan area." It is believed that the central authority for education in this area will be the County Council, but administrative details will be left in the hands of the borough councils to a greater extent than is the case with the local authorities under the extra-metropolitan Act of last year.

The current number of the *Library* summarises, in a convenient tabular form, Mr. Carnegie's gifts to libraries and other educational institutions down to November 30 of last year. From these tables it is seen that England and Wales have benefited to the extent of 376,100*l*., this amount including a donation of 50,000*l*. to the University of Birmingham and one of 13,000*l*. to the Iron and Steel Institute. Ireland has received 100,600*l*. and Scotland 2,479,250*l*. The princely gift to Scotland includes the endowment fund of 2,000,000*l*. for Scottish universities, a sum of 100,000*l*. given to the Technical School at Galashiels, 38,000*l*. to the Dunfermline Technical School, and 50,000*l*. to Aberdeen University. Canada has received 954,000 dollars, which represents the total sum given for the foundation of thirty-one public libraries. Libraries and other educational institutions in the United States have reaped the advantage of Mr. Carnegie's munificence to the enormous extent of 212,882,173 dollars. The Fayette Upper University, Iowa, has received 225,000 dollars; the Louisville Polytechnic Institute 125,000 dollars; the Carnegie Laboratory of New York City 600,000 dollars; the Pennsylvania State College 100,000 dollars; the Carnegie Institute at Pittsburg 7,250,000 dollars; the Polytechnic School of the same place, as an endowment, two million dollars; and the National University of Washington ten million dollars. Cuba, too, has shared in the same lavish generosity, for Havana has received 250,000 dollars and Matanzas 2000 dollars.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 22.—"Solar Eclipse of 1900 May 28. General Discussion of Spectroscopic Results." By J. **Evershed**, F.R.A.S.

The spectra discussed in this paper were obtained near the southern limit of total eclipse, and include, therefore, the chromospheric spectrum of the south polar region of the sun, as well as the same spectrum in mid-latitudes.

The coincidence in position of the vast majority of the bright lines with the Fraunhofer dark lines is shown to be exact within the limits of the measures. But the relative intensities of the bright lines of any one element, although in general agreement with those of the corresponding dark lines, are not in all cases the same, and those lines which are exceptionally strong in the chromospheric spectrum are mostly lines which are enhanced in the spark spectrum of the element.

All the more prominent enhanced lines of iron and titanium as determined by Sir Norman Lockyer are found to coincide with strong lines in the chromosphere, and these lines are found to be equally prominent in the south polar region and in mid-latitudes.

The abnormal intensity of the enhanced spark lines in the flash spectrum is explained by assuming a continuous circulation of the solar gases in a radial direction, the highly heated ascending gases, emitting the enhanced lines, giving the predominant features to the chromospheric spectrum, whilst the cooler, more diffused gases, slowly subsiding, determine the character of the absorption spectrum.

The entire chromosphere is supposed to consist of innumerable small eruptions or jets, of a similar nature to the so-called metallic prominences, which latter are only the more pronounced manifestations of the same eruptive agencies.

Evidence for this is found in the characteristic features of the chromosphere, and in the structure of many of the Fraunhofer lines, which show emission lines underlying the narrow absorption lines. These ill-defined bright lines in the normal solar spectrum are displaced towards the violet, indicating a strong uprush of the hotter gases, whilst the narrow dark lines would appear to indicate a slow and uniform descent of the absorbing gases.

The final conclusion is that the spectrum of the chromosphere represents the emission of both ascending and descending gases, and the Fraunhofer spectrum represents the absorption of the descending gases only.

"Preliminary Note on the Relationships between Sun-spots and Terrestrial Magnetism." By Dr. C. **Chree**, F.R.S.

This deals with results of magnetic declination, inclination, horizontal and vertical force obtained at Kew Observatory (National Physical Laboratory) on magnetically quiet days from 1890 to 1900. The ranges of the diurnal inequalities are compared with the sun-spot frequencies as calculated by Wolfer. Between the diurnal range R of an element and the sun-spot frequency S, a linear relation $R = a + bS$ . . . (1) is assumed, a and b being taken as constants for any given month of the year, but as fluctuating from one month to another. The values of a and b have been calculated for each month of the year from the eleven years' data by least squares. The preliminary note gives the mean values for "winter," "equinox" and "summer"—including four months in each season—and the mean for the twelve months. The constants a, representing the values of the range for zero sun-spot frequency, are smallest in winter and largest in summer. The constants b are in the case of the declination, inclination and horizontal force—where the sun-spot connection is more clearly marked than in the vertical force—largest at the equinox. The variation of b with the season appears closely the same for the three magnetic elements specified. On the average of the three, the proportional values obtained for b are, winter 82, equinox 115, summer 103. Whilst b, considered absolutely, appears largest at the equinoxes, the sun-spot influence (or rather correlation) is relatively much most important in winter. During the eleven years considered, Wolfer's mean sun-spot frequency was 41·7; so that, according to (1), $1 + 41 \cdot 7b \div a$ represents the ratio of the range answering to mean sun-spot frequency to the range answering to absence of sun-spots The average values of $41 \cdot 7b \div a$ for the declination, inclination and horizontal force in winter, equinox and summer respectively were 0·57, 0·38 and 0·27. The means of the twelve-monthly absolute values found for b were, declination 0'·041, inclination 0'·013, horizontal force 0·19γ and vertical force 0·03γ, where γ represents 1×10^{-5} C.G.S. Reference is made to work by Balfour Stewart, Ellis, Wolfer, Rajna and Angot, and the legitimacy of the use of Wolfer's table of sun-spot frequencies is considered.

January 29.—"On Skew Refraction through a Lens, and on the Hollow Pencil given by an Annulus of a very obliquely placed Lens." By Prof. J. D. **Everett**, F.R.S.

The investigation here described was undertaken with the view of finding an explanation of the curious curves obtained by receiving on a screen, at certain distances, the hollow pencil which emerges from an annulus of a lens placed at a large obliquity (such as 30° or 45°) to the incident beam.

The first requisite is a process for calculating the direction cosines of a ray after refraction at a given surface, when those of the incident ray and of the normal are given, along with the relative index of refraction; and the leading feature of the process here described is, *the preliminary calculation of the direction cosines of the tangent to the refracting surface in the plane of refraction.* The refracted ray (or unit length of it) is projected on this tangent and on the normal; and these two projections are themselves projected on the axes of coordinates, and added. This process differs *in toto* from that devised by Seidel and employed by Steinheil.

A simple case is chosen for testing the working of the process, the case of a narrow and thin annulus of a plano-convex lens, with a parallel pencil incident at 45° on its plane face, the index being 1·5, and the sine of the inclination of the normals to the axis 0·1. The direction-cosines are found for the emergent rays at twelve equidistant points; and from these, by harmonic reduction, expressions are deduced for the direction-cosines of any emergent ray. From the equations of the rays in terms of the direction-cosines and starting-points, numerous cross-sections are calculated and plotted.

Each ray intersects two others, and the aggregate of these points of intersection constitutes the two focal lines. The secondary line is found to be nearly straight, and inclined at about 17° to the original direction of the beam. The primary line is approximately a parabola, the chord joining its ends being about $1\frac{1}{6}$ the distance of the chord from the vertex. The vertex is next the lens, and is the intersection of the two rays which lie in the principal plane. The rays which intersect at its ends have starting-points 79° distant from one of these rays, and 101° from the other.

Every cross-section shows a double point wherever it meets a focal line; and at the ends of the two focal lines these double points become cusps. The ends of the primary line have been located, and the rays which pass through them found as above, by means of the conditions for a stationary point, which must always hold at a cusp.

Chemical Society, February 5.—Dr. E. Divers, F.R.S., vice-president, in the chair.—The following papers were read:—The solubilities and transition points of lithium nitrate and its hydrates, by Dr. F. G. **Donnan** and Mr. B. C. **Burt.** Lithium nitrate was found to yield two hydrates, $LiNO_3,3H_2O$ and $LiNO_3,\frac{1}{2}H_2O$. Determinations of the solubility of these hydrates and of the anhydrous salt were made, and the various quadruple points thus located confirmed by thermometric and dilatometric measurements.—The synthesis of $\alpha\alpha$-diglutaric acid, by Drs. O. **Silberrad** and T. H. **Easterfield**.—Distillation of chlorine water, by Dr. A. **Richardson**. When chlorine water is distilled below 100° C. the distillate contains free chlorine; the residue left in the retort liberates iodine from potassium iodide, bleaches indigo solution immediately and gives the usual reactions obtained with hypochlorous acid. Distillation of chlorine water in a current of chlorine gas shows that the hydrochloric acid formed in the residue is equivalent to the hypochlorous acid found in the distillate, indicating that a portion of the chlorine reacts with the water thus, $Cl_2 + H_2O = HCl + HClO$. When chlorine water is heated in a flask provided with a reflux condenser no change in its composition occurs.—A new vapour density apparatus, by Mr. J. S. **Lumsden**. This apparatus is based on the principle that the molecular weights of all substances in the state of gas, when occupying the same volume at the same temperature, exert the same pressure. From the pressure produced by vaporising a weighed quantity of a substance the molecular weight of which is required, the weight in milligrams which would produce the milligram molecular pressure is calculated and taken as the molecular weight.—A new form of pyrometer, by the same. A further application of the principle employed in the foregoing apparatus. A constant volume instrument, made of glass, porcelain or metal, is used, in which a weighed quantity of a substance is vaporised and the pressure measured by a mercury gauge. The pressures produced by equal weights of substances are proportional to the absolute temperatures; therefore, if at two temperatures the pressures produced by equal weights are measured and one temperature is known, the second is determinate.—Tertiary butyl phenol, by Mr. E. W. **Lewis.** The non-formation of phenyl-*ter*-butyl ether when phenol in alcoholic solution is digested with *ter*-butyl chloride and alkali affords an instance of the difficulty attending the preparation of phenyl ethers containing a tertiary radical in place of the hydrogen atom of the phenolic hydroxyl.

Mathematical Society, February 12.—Prof. H. Lamb, president, in the chair.—The following papers were communicated:—Lieut.-Colonel **Cunningham,** On 4ic residuarity and reciprocity. The criterion for distinguishing the plus and minus signs in the congruence denoted, after Dirichlet, by $(q/p)_4 = \pm 1$, is the object of investigation. Reductions of the criterion to convenient forms are given and the properties of the symbol $(q/p)_4$ are developed. Tables are appended giving the quadratic partitions (when possible) of all primes less than 500.—Mr. E. T. **Dixon**, Note on a point in a recent paper by Prof. D. Hilbert. It is pointed out that in the non-Pythagorean geometries devised by Hilbert, Helmholtz's axiom of monodromy is not verified, inasmuch as it is possible, by rotation through four right angles, to bring the points of a line into positions which they do not occupy before the rotation. It is pointed out further that, in the same geometries, it is possible to pass from one point to another of a straight line without passing through all intermediate points and without leaving the line. The application of the name "geometry" to systems which admit such possibilities is criticised.—Mr. H. **Hilton**, Some properties of binodal quartics. Properties of bicircular quartics are deduced from those of spheroconics by stereographic projection, and properties of binodal quartics are then deduced by plane projection.—Prof. A. W. **Conway,** The field of force due to a moving electron. The electron is treated as a point singularity of the electromagnetic equations, and formulæ to express the field of force about the electron, when moving with any velocity, are obtained. The amount of radiation from the electron is calculated.—Prof. W. **Burnside,** An arithmetical theorem connected with the roots of unity, and its application to group characteristics.

Royal Microscopical Society, Annual Meeting, January 21.—The president, Dr. Hy. Woodward, F.R.S., in the chair.—A series of twenty-four photomicrographs in colour was exhibited by Mr. Albert **Norman,** who said the examples shown were an application of the Sanger Shepherd process to medical photomicrography. The examples shown comprised histological and pathological sections, malaria and tse-tse fly parasites, and various bacilli, including tetanus and typhoid showing the flagella.—The **President** delivered his annual address, its title being "Some Ideas on Life," based on the development of life as shown by fossil organisms found in geological strata.

Mineralogical Society, February 3.—Prof. H. A. Miers, vice-president, in the chair.—Mr. L. **Fletcher** gave an account of the fall of a meteoric stone on August 22, 1902, at Caratash, Smyrna, and also contributed a note on the history of the mass of meteoric iron found in the neighbourhood of Caperr, Patagonia.—Mr. H. L. **Bowman** gave the results of determinations of the refractive indices of pyromorphite and vanadinite by means of artificially ground prisms having an angle of about 30°. For red light the refractive indices of pyromorphite were $\omega = 2.139$, $\epsilon = 2.124$, and of vanadinite, $= 2.354$, $\epsilon = 2.299$.—Mr. T. V. **Barker** described quartz crystals of peculiar habit which were collected by Lieut. E. G. Spencer-Churchill near De Aar, South Africa. Two crystals were remarkable as exhibiting faces seldom observed on quartz, one face in the zone *mz* and another in the zone *rz*.

Geological Society, January 21.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The figure of the earth, by Prof. W. J. **Sollas**, F.R.S. The almost precise correspondence of great terrestrial features with a circular form seems to be frequently overlooked. The Aleutian curve has its centre in latitude 6° N., longitude 177° W., that of the East Indies about 15° N. and 118° E., and round the latter centre are several concentric curves. The northern part of South America, the Alpine-Himalayan chain, the western shore of North America and a portion of Australia may be similarly reduced to geometric form. A great circle swept through the centres of the East Indian and Aleutian arcs runs symmetrically through the bordering seas of Asia as far as Alaska, borders the inland lakes of America, passes the Californian centre, extends through the middle of the Caribbean Sea, runs parallel with the coast of the Antarctic Continent, and returns to the East Indian centre without touching Australia. This course is in remarkable correspondence with the general trend of the great zone of Pacific weakness. If the pole of this circle in the Libyan Desert is placed towards an observer in a globe, the African Continent appears as a great dome surrounded by seas and separated from the Pacific by an irregular belt of land. A second great circle defined by Lake Baikal, and with its centre at "the morphological centre of Asia" of Suess, and passing through the East Indian centre, may be regarded as the direction-circle for the Eurasian folding. These two centres intersect at an angle of 39°, and, on bisecting this angle, a mean directive circle is found, with its pole near the sources of the White Nile, 6° north of the Equator. The axis of terrestrial symmetry through this pole passes through the middle of Africa and of the Pacific Ocean. The smallest circle which will circumscribe Africa has its centre near this pole, and within it the symmetry of the fractured African dome is observable. Outside this comes a belt of seas, and outside that again the Pacific belt of continents, the Antarctic, South America, North America, Asia and Australia. Mr. Jeans has concluded on mathematical grounds that the "pear-like shape of the earth" might have been possessed by it at the time of its consolidation; and he has suggested that Australia may represent the "stalked end" of the "pear." The author's observations would lead him to place it in Africa, and to regard the Pacific as covering the "broad end."—The sedimentary deposits of Southern Rhodesia, by A. J. C. **Molyneux**. The greater portion of the area of Southern Rhodesia lies on granite and gneiss, and on the schists and slates that contain the auriferous veins worked in ancient times, and now being again opened up on an extensive scale. The remaining area is on sandstone and other sedimentary beds, with coal-deposits and regions of volcanic rocks. To explain the deposition and order of these sediments several sections are given, one being along a line extending from the Zambesi River on the north, through Bulawayo and the central plateau, to the Limpopo River on the south, a distance of more than 400 miles. Another section, with remarks thereon, is copied, by permission, from a report by Mr. C. J. Alford on the coal-bearing rocks of the Mafungibusi District. Three appendices are added; one, on a new species of Acrolepis from the Sengwe Coalfield; a second, on some Lamellibranch Mollusca; and a third, on some fossil plants from Rhodesia.

Zoological Society, February 3.—Mr. Howard Saunders, vice-president, in the chair.—Dr. Walter **Kidd** read a paper describing the arrangement of hair on four mammals, the otter, domestic dog, ox and horse, considered as typical from the point of view of hair-slope. The rising complexity of these phenomena in the four forms was shown to be closely related to their differing habits and environments, and a division was made of adaptive and non-adaptive modifications of hair. It was maintained that the facts dealt with were closely connected with the problems of heredity.—A communication from Captain F. **Wall**, of the Indian Medical Service, contained an account of all the snakes hitherto recorded from China, Japan and the Loo Choo Islands, together with notes on those obtained by himself during the time he was attached to the China Expeditionary Forces in 1900-1902.—Mr. H. J. **Elwes**, F.R.S., read a paper on the variation of the elk, in which it was pointed out that from the author's personal experiences in Norway during six years' hunting he could entirely confirm the observations of Dr. Lönnberg. Specimens showing variation in the antlers of the elk from Norway were exhibited.—Mr. R. **Lydekker** gave a description of the wild sheep of the Kopet Dagh, the range of mountains forming the northern boundary of Persia; this race had been named *Ovis arkal*, in 1857, by Blasius. Mr. Lydekker considered that this animal formed a recognisable subspecies of the Urial, and proposed to call it *Ovis vignei arkal*.—Staff-Surgeon P. W. **Bassett-Smith**, R.N., communicated a paper on three new parasitic Copepoda obtained by Mr. Cyril Crossland in East Africa.—A short paper was read by Colonel C. E. **Stewart**, C.S.I., in which he contended that the tiger was a recent intruder into the Peninsula of India. His reason for believing this was the absence of any Sanscrit word for tiger, and also the absence of any allusion to tigers among many of the older writers.—A communication was read from Prof. Sydney J. **Hickson**, F.R.S., containing a description of a new Hydrozoan obtained by Mr. Cyril Crossland in Zanzibar, for which the name *Ceratella minima* was proposed.—Dr. G. Herbert **Fowler** presented an eighth contribution to our knowledge of the Plankton of the Faeroe Channel, which dealt mainly with the Ostracoda, Copepoda, Amphipoda and Schizopoda captured during a cruise of H.M.S. *Research*, and their horizontal and vertical distribution. Short diagnoses by Dr. Wolfenden of three new species of Copepoda were given.

Paris.

Academy of Sciences, February 9.—M. Albert Gaudry in the chair.—On the gradual extinction of the motion at the back of an isolated wave, in an elastic medium having a resistance proportional either to the velocity or the displacement, by M. J. **Boussinesq**.—On the equations of motion and the supplementary relation in the midst of a vitreous medium, by M. P. **Duhem**.—Remarks by M. Alfred **Picard** on the first volume of his report on the Exhibition of 1900.—The **President** announced to the Academy the death of M. Lechartier, correspondant for the section of rural economy.—On entire functions of infinite order and differential equations, by M. Edm. **Maillet**.—On functional operations, by M. **Hadamard**.—On a theorem analogous to that of Bobillier, in the case of the rolling of a surface on an applicable surface, by M. G. **Kœnigs**.—Temporary and permanent changes in nickel steels, by M. Ch. E. **Guillaume**. The permanent changes undergone by a bar of nickel steel have been observed over a period of six years, and amounted to about 12 μ. The amount of this change is too great for the alloy to be safely used for the construction of length standards of the first order, but serviceable secondary standards may be made, provided that comparisons with a primary standard are made at intervals.—On the variation of the mean velocity of the wind in the vertical, by M. Axel **Egnell**. The quantity of air displaced in the wind is constant at all heights from 300 metres to 12,000 metres. From this follows the very simple law that the mean velocity of the wind is in inverse proportion to the density of the air.—On a magnetic apparatus serving as a detector for electric waves, by M. G. **Tissot**.—On the disappearance of the radio-activity induced by radium on solid bodies, by MM. P. **Curie** and J. **Danne**. After a certain period the intensity of the radiation follows an exponential law with the time, of the form $I = I_0 e^{-\frac{t}{\theta_1}}$. In general this law is independent of the nature of the radiating body, but for a few substances, of which celluloid is the best type, the activity decreases much more slowly, taking several days to fall to one-half.—On the displacement of the sulphuric acid of alkaline bisulphates by water, by M. Albert **Colson**. From a thermochemical study of the behaviour of solutions of sodium bisulphate the conclusion is drawn that this salt can react with water to give sulphuric acid and the neutral sulphate. An attempt will be made to utilise this reaction on the large scale.—On a new synthesis of orthodiazine, by M. R. **Marquis**. The diazine is obtained by the action of hydrazine hydrate upon maleic aldehyde. On the reduction of the diazine with sodium and alcohol, a small quantity of tetramethylene-diamine is produced, together with ammonia.—On the formation of azo-bodies. The reduction of orthonitrobenzyl alcohol, by M. P. **Freundler**.—The oxidation of the acetates of manganese and cobalt by chlorine, by M. H. **Copaux**. The acetates of cobalt and manganese

behave differently towards chlorine; in the first case a complicated chloroacetate of the oxide Co_3O_4 is obtained, and in the second a manganese acetate derived from the sesquioxide.—Study of the action of selenyl chloride upon mannite, by MM. C. **Chabrié** and A. **Bouchonnet**.—The synthesis of anisic acid and paraethoxybenzoic acid, by M. F. **Boudroux**. Monobromo derivatives of phenols react readily with magnesium in the presence of anhydrous ether, and the magnesium compounds produced absorb carbon dioxide. The product of this reaction, treated with hydrochloric acid, gives the corresponding carboxylic acid. Acids have been obtained in this way from anisol and phenetol.—Studies in the pyrane series, by M. R. **Fosse**.—The migration of the methyl group under the action of hydriodic acid, by M. E. E. **Blaise**.—On a new orthocyclohexanediol and its derivatives, by M. Léon **Brunel**.—On two new glucotannoids, by M. Eugène **Gilson**.—On the essence of *Calamintha Nepeta* or *Marjolaine* in the south of France, by MM. P. **Genvresse** and E. **Chablay**. The essence contains pinene, pulegone and a new ketone, calaminthone, the properties of which, together with those of its oxime and semicarbazone, are described. Nascent hydrogen transforms this ketone into menthol.—Morphogenesis in *Salmacina Dysteri*, by M. A. **Malaquin**.—On the presence of glucose in the cephalorachidian fluid, by MM. L. **Grimbert** and V. **Coulaud**.—On the nutrition of *Sterigmatocystis nigra*, by M. Henri **Coupin**. Iron, silicon and zinc are not used for nutrition by *Sterigmatocystis nigra*, zinc even retarding the development. The mycelium is capable of furnishing the acidity necessary for the entire development.—On a disease of the branches of the fig, by M. A. **Prunet**.—On phthiriosis, a disease of the vine caused by *Dactylopius Vitis* and *Bornetina Corium*, by MM. L. **Mangin** and P. **Viala**. The disease is very prevalent in the vine in Palestine. The use of carbon bisulphide injected into the soil is recommended for combating the disease.—On a caoutchouc-bearing plant of the Lower Congo, by M. E. de **Wildeman**. The plant is a new species of Clitandra, resembling *C. orientalis*; it is named *C. Arnoldiana*.—On vegetative activity at the epoch of the Coal-measures, by M. B. **Renault**. From a study of the fossils in coal, it is concluded that the cellular tissues possessed a greater activity of formation than at present, this activity being favoured by an appropriate vascular development.—On a special type of dunes on the borders of the Sahara, by M. B.-P.-G. **Hochreutiner**.—On the reduction of oligiste and magnetite by hydrocarbons, by M. L. de **Launay**.—An experimental contribution to the knowledge of life and muscular reactions, by MM. Ed. **Toulouse** and Cl. **Vurpas**.—On the lifting effect developed by the rotation of helices with vertical axes, by M. Henri **Villard**.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 19.

ROYAL SOCIETY, at 4.30.—On the Formation of Definite Figures by the Deposition of Dust: Dr. W. J. Russell, F.R.S.—Mathematical Contributions to the Theory of Evolution. On Homotyposis in Homologous but Differentiated Organs: Prof. Karl Pearson, F.R.S.—The Evaporation of Water in a Current of Air (Communicated by Prof E. H. Griffiths, F.R.S.): Dr. E. P. Perman.—On the Determination of Specific Heats, especially at Low Temperatures: H. E. Schmitz.

ROYAL INSTITUTION, at 5.—Arctic and Antarctic Exploration: Sir Clements Markham, K.C.B.

LINNEAN SOCIETY, at 8.—Electric Pulsation in *Desmodium gyrans*: Prof. J. C. Bose.—*Cerataphis Lataniae*, a remarkable Aphid: Alice L. Embleton.—Specialisation of Parasitism in the Erysiphaceæ: S. E. Salmon.

FRIDAY, FEBRUARY 20.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

ROYAL INSTITUTION, at 9.—The Measurement of Energy: Principal E. H. Griffiths.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Hydraulic Experiments on a Plunger Pump: Prof. John Goodman.—Experiments on the Efficiency of Centrifugal Pumps: Thomas E. Stanton.

MONDAY, FEBRUARY 23.

SOCIETY OF ARTS, at 8.—Paper Manufacture: Julius Hübner.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Further Explorations in the Canadian Rockies: Prof. Norman Collie, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—Further Remarks on the Valuation of Endowment Assurances in Groups: George J. Lidstone.

TUESDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 5.—Recent Advances in Photographic Science: Sir William Abney, K.C.B.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Bronze Bells an other Objects from Nigeria: C. Partridge, jun.—Stone Implements from Perak: R. Swan.

SOCIETY FOR THE PROMOTION OF HELLENIC STUDIES, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mechanical Handling of Material: G. F. Zimmer.

WEDNESDAY, FEBRUARY 25.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of Dictyozamites in England, with Remarks on European and Eastern Floras: A. C. Seward, F.R.S.—The Amounts of Nitrogen and Organic Carbon in some Clays and Marls: Dr. N. H. J. Miller.

SOCIETY OF ARTS, at 8.—Tonkin, Yunnan and Burma: F. W. Carey.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Discussion on the Panama Canal and the Introduction of Yellow Fever into Asia, to be opened by Dr. Patrick Manson, F.R.S.

UNIVERSITY COLLEGE CHEMICAL AND PHYSICAL SOCIETY, at 8.30.—The Attainment and Measurement of Low Temperatures: Dr. M. W. Travers.

THURSDAY, FEBRUARY 26.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Solid Solutions and Chemical Transformation in the Bronzes: C. T. Heycock, F.R.S., and F. H. Neville, F.R.S.

ROYAL INSTITUTION, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

SOCIETY OF ARTS, at 4.30.—Gleanings from the Indian Census: J. A. Baines.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Nernst Lamp: J. Stöttner.—And, *if time permit*, Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuit by the Aid of Oscillograms: M. B. Field.

FRIDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 9.—Perfumes: Natural and Artificial: Dr. A. Liebmann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Relative Advantages of Single Screws, Twin Screws, and Triple Screws, for Marine Propulsion: E. Falk.

SATURDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

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THURSDAY, FEBRUARY 26, 1903.

THE LIVING SUBSTANCE—A THEORY.

Die Biogen-hypothese. By Prof. Max Verworn. Pp. iv+114. (Jena: Fischer, 1903.) Price 2.50 marks.

THE author of the well-known work on "Allgemeine Physiologie" is always interesting in his physiological writings, whether one admits the validity of his conclusions or not; and the volume before us, though highly speculative in its nature, cannot fail to attract attention, no less on account of the intrinsic importance of the subject than by reason of the lucidity with which a difficult topic is handled.

The Biogen-hypothese is nothing less than an attempt to frame a working hypothesis that shall render intelligible the *modus operandi* of a living organism and to explain in a comprehensive manner the general nature of the physical and chemical processes involved. Such an explanation, as the author himself insists, can only be regarded as a temporary expedient in the present condition of our knowledge, but the author of a theory or hypothesis is amply justified in propounding it if he is enabled thereby to indicate definite lines of investigations, whatever the influence the results thereby obtained may exercise on the theory itself.

The various hypotheses that have been put forward to account for the facts of metabolism are briefly discussed and the nature of the respiratory process is specially considered. It seems quite clear from the results of numerous investigators that whatever the nature of the sequence of chemical events, the carbohydrates are proximately the substances that are most intimately affected. These carbohydrates might be derived directly from the store of accumulated reserve products, or an analogous atom group might be split off from the more complex proteid-like bodies. On the whole, the latter seems the more probable view, and thus dissimilation and assimilation form a constantly oscillating series of phenomena that give rise to the pr ocesses described as metabolism.

The biogen is regarded by Verworn as a real chemical or physical entity, consisting of various groups of atoms held together round a central benzene nucleus. Dissimilation, or katabolism, occurs when certain atom-groups are split off from the biogen, and normally these represent carbohydrates or some similar bodies, a view which is by no means new and one that finds support, for example, in the behaviour of muscle when it is made to do work. For it is well known that the excessive amount of carbon dioxide excreted in such circumstances is not accompanied by a correspondingly increased excretion of nitrogenous waste-products. On the contrary, the nitrogenous remainder of what Verworn terms the biogen regenerates itself by seizing upon the available sugars or other carbohydrates. A distinction is drawn between this "functional" dissimilation and the "destructive" dissimilation that follows on extreme starvation; for in the latter case the nitrogen-containing remainder of the biogen undergoes further decomposition, and then the simpler groups thus produced no longer possess the faculty of regeneration at all and so are unable to reproduce the living substance once more.

As to the cause of the lability of the biogen, Verworn strongly champions the view that it is the result of the incorporation of oxygen in the molecule, and that when irritability ceases, on arresting the supply of this gas, it is not due to the possible inhibitory action of the accumulating waste products, but that in the absence of oxygen the conditions of adequate lability are not provided. The arguments are largely based on the behaviour of frogs that have been poisoned by strychnine and in which an artificial circulation by means of salt solution is maintained. This can be so arranged as to provide or withhold oxygen from the tissues. In the latter case, stimulation ceases to excite contraction in the muscles, though on readmitting oxygen, tetanus is easily produced on the application of suitable stimuli. If a long interval of time is allowed to elapse during which no food is being conveyed to the tissues, starvation, and consequent reduction in the number of labile biogens, ensues. Hence stimuli gradually provoke weaker and weaker responses. If once more the supply of oxygen is cut off, loss of excitability again supervenes, but this passes away again on readmission of oxygen. Verworn seems to conclude that because this return of excitability recurs at once, both in the unstarved and starved tissue, the inhibition effect of the deprivation of oxygen cannot be ascribed to the accumulation of waste products, since in the former case this should have been of much greater magnitude in correspondence with the much larger amount of waste substances, and, therefore, the *rôle* of the oxygen must have been that of a labilising agent, directly producing the condition for explosive decomposition in the active biogens. But it is not shown whether the influence of waste products upon the hypothetical biogens may not be a proportionate one, in which case there would be perhaps no very obvious reason why any difference should be looked for in the two cases. Moreover, it is quite clear that the free oxygen does oxidise harmful waste products and reduce them to a form (*e.g.* carbon dioxide and water) in which they may be either innocuous or at least readily escape from the tissues. The accumulation of alcohol in plant tissues in the absence of oxygen is a case in point, and readmission of oxygen has the immediate result of increasing the output of carbon dioxide at the expense of the alcohol abnormally present in the tissues.

The biogen hypothesis gives a plausible account of growth and the production of fresh living material by supposing that the molecule is capable of polymerisation and then of falling into simpler substances once more. But this view would seem further to imply that the more highly polymerised bodies do not differ essentially in their properties from the more simple ones. In endeavouring to locate the seat of the biogens in the cellular organisation, it is concluded that they exist in the cytoplasm but not in the nucleus. The evidence for this is based on observations adduced to show that enucleated protoplasm can exhibit metabolic activity, and further, that the oxidative charges are more especially obvious in the cytoplasmic, rather than in the nuclear, constituents of the cell. But perhaps one may reasonably question the

advisability of endeavouring to go so far. We are as yet far too ignorant of the nature of the relations existing between cytoplasm and nucleus to be able to draw any safe general conclusions respecting them. What we do know suffices to prove that, probably as the result of interchange of material, the relations are at least of a very intimate nature.

It is, of course, impossible within the limits of so short a notice to attempt to do anything like full justice to the skilful treatment that Prof. Verworn has brought to bear on his subject. It must suffice to repeat that it is thoroughly well worth reading, and whatever may be thought of the tenability of the hypothesis itself, one can hardly deny that it does fulfil the important condition of enabling one to link together in a suggestive manner a large number of very complicated phenomena.

SCIENCE AND PRACTICE.

The Lighthouse Work of Sir James Chance, Bart. Pp. x + 162. (London: Smith, Elder and Co., 1902.) Price 5s. net.

THE optics of lighthouse lenses form a sufficiently fascinating subject, and its interest, apart from its practical importance, has attracted able men from Augustin Fresnel down to John Hopkinson. Among these, James Timmims Chance deservedly holds a prominent place, and his biographer has earned our thanks by the account he has given in the pages under notice of Chance's life and work.

Sir James Chance, a son of Mr. William Chance, of Birmingham, one of the partners in the glass-making firm of Chance Bros. and Co., was born in 1814. After gaining honours in various subjects, including Hebrew, at University College, London, he entered Trinity College, Cambridge, and in 1838 he graduated as seventh wrangler. Immediately after this he entered his father's firm, of which he remained a partner for fifty years, being head of the firm for twenty-five. He was made a baronet by her late Majesty on the occasion of her last distribution of birthday honours. He died on January 6, 1902.

In old days, parabolic reflectors were used for lighthouses; the employment of lenses is due to Augustin Fresnel, who in 1819 erected the first dioptric system at the Tour de Cordouan; the system was extended by his brother Leonor and other distinguished men in France, and in Great Britain by the family of Stevenson, by Airy and by Faraday. With the two latter Mr. Chance became intimately associated about the year 1859.

His firm had manufactured lighthouse lenses for some years previously. Before this, the industry had been crushed out in England by Excise regulations; an Order in Council was required to permit of their manufacture, and a duty amounting to some 300 per cent. on the cost of the glass was enforced. In consequence, Messrs. Swinburne and Co., of South Shields, who for a few years had manufactured lenses, gave up the work in 1845. In 1850 Messrs. Chance took it up. They engaged a French expert, M. Tabouret, who had worked for Fresnel himself, and he exhibited in the Exhibition of 1851 an apparatus of the first order, made at Messrs. Chance's Spon Lane works. In the years that followed, the work prospered, the plant was increased and the optical part of a number of lighthouses was manufactured. M. Tabouret left the firm in 1853.

In 1859 the work of the Commission to inquire into the condition of the lights, buoys and beacons of the United Kingdom began. Airy and Faraday had charge of the scientific side of the inquiry. Mr. Chance's assistance was called in as a manufacturer of great experience, and it was soon found that in him the Commission had an adviser who could render services of the highest value. His mathematical training enabled him to understand and develop the theory of the subject, his practical experience showed him what was possible. He had already introduced improvements into the method of grinding the annular lenses which form the system, and its various components had reached a high degree of perfection.

But, though this was so, the distribution of light effected by means of the lens system was, in many cases, entirely wrong. At that time Messrs. Chance were not allowed even to tender for the frames to hold the lenses, although they had to make these in order to adjust the system in their workshop. They had no share in the erection or adjustment of the light, which was done usually by contractors with little or no optical knowledge, and the result was failure. One of the most glaring instances was the Whitby light, of which Airy reported:—"The dioptric part of the apparatus is beautiful. The glass is of the best quality. . . ." The adjustments, however, were all wrong.

"My impression is," he writes, "that in the north lighthouse three-fourths of the light is absolutely thrown away, and in the south lighthouse nine-tenths of the light is absolutely thrown away. . . . When with a ruler I covered the part of the flame which merely gave light to the sky, it was absurd to see how little was left for the useful part. . . . It really gave me a feeling of melancholy to see the results of such exquisite workmanship entirely annihilated by subsequent faults in the mounting and adjustment."

In the end, Mr. Chance was given a free hand. Airy again reports, at a later date,

"The said constructor"—Mr. Chance—"is willing to go heartily into the improvement of the Whitby light, therefore leave all others and rest on it."

And this wise advice was taken.

A method of adjustment—it seems sufficiently obvious, and had been used previously—was suggested by Airy and employed in setting up the lenses. Each portion of the lens system is to be employed in forming an image of some part of the lamp flame on the distant horizon or on some part of the sea between the lighthouse and the horizon. Conversely, if the adjustment is correct, a real image of that part of the horizon will be formed by the lens system on the corresponding part of the flame, and can be seen by an observer looking into the lens system from behind.

Airy's method consisted in adjusting the lenses in turn until the image of the horizon formed by each occupied its proper position with regard to the flame.

It is clear that the adjustment will depend in part on the position of the lighthouse, especially on its height above sea-level, and that a system of lenses put together without any reference to this was bound to be wrong.

The results were entirely satisfactory, and the Whitby light when reconstructed gave admirable results.

A good deal of correspondence followed with some members of the Commission as to the form of lamp and the best height for the principal focus of the system above the wick, and as time went on various other improvements were introduced; but Mr. Chance's position was now assured, and is evidenced by the long list of splendid lights we owe to him.

One of the improvements worked out in collaboration with Mr. Thomas Stevenson is the dioptric mirror, whereby the rays which leave the lamp at the back are totally reflected by suitable curved prisms and issue in the direction in which the light is required to travel.

The whole book, however, is most interesting, and forms a striking illustration of the application of science to industry. Mr. Chance realised the need of this, and his success was the consequence.

His contributions to the mathematical side of the subject are summed up in two papers read before the Institution of Civil Engineers in 1867 and 1879. The first deals with lighthouses in general; its value as a reprint is, however, impaired by the omission of the careful figures by which it was illustrated; in the second, the question of the application of the electric light to lighthouses is considered. Electric light was employed at the South Foreland in 1872 and at the Lizard lighthouse in 1878. The apparatus in the latter case was designed by John Hopkinson, who on Mr. Chance's retirement became scientific adviser to the firm.

R. T. G.

THE INFINITIES OF MATHEMATICS.

Die Grundsätze und das Wesen des Unendlichen in der Mathematik und Philosophie. Von Dr. Phil. Kurt Geissler. Pp. viii + 417. (Leipzig: Teubner, 1902.) Price 14 marks.

EVERY serious inquiry leads, sooner or later, to metaphysics, and thus to antinomies which no merely logical process can reconcile. The pure mathematician is one of the first to reach this conclusion, because his methods are mainly logical, and the notions with which he deals are few and abstract. Why is it, then, that (as a rule) he regards the philosopher with a mixture of pity and disdain, and rarely takes part in any strictly metaphysical discussion? Each is vitally concerned with number, space and time; why do the conclusions of the one appeal so little to those of the other? Leaving the philosopher to answer for himself, we may endeavour to construct the mathematician's apology.

It is mainly that, while he reaches the fundamental paradoxes as soon as the metaphysician, his attitude towards them is different. As it seems to him, the philosopher, after an imperfect analysis, tries to save the situation by a still more imperfect transcendental synthesis. To swamp all distinctions in the Absolute, while assuring us that the distinctions persist, is a childishly simple course, especially when adopted by someone who has a very vague conception of the distinctions which he proposes to abolish. Surely it is reasonable to examine our concepts as carefully as we can, to discover, if possible, which are simple and which are derived or composite. Until we do this, we have no right to say what are the ultimate logical inconsistencies, still less how we propose to reconcile them. The presuppositions of arithmetic and geometry have recently been analysed with great care, and definite results of primary importance have been obtained; the philosophical bearing of these conclusions is obvious, and henceforth no metaphysical theory that ignores them will be accepted by mathematicians. Difficulties remain, of course; some have emerged which were previously unsuspected; but at any rate the ground has been cleared of many merely sophistical paradoxes, and the real issues have been made clearer.

Dr. Geissler's book is rather pathetically disappointing; he has evidently tried to master modern critical theories, but has failed in the attempt. The whole arrangement of the work is unsatisfactory, starting as it does with a vague spatial intuition, and constantly mixing up arithmetical difficulties with those of geometry. In the forefront of all discussions of mathematical infinity must be put the notion of the arithmetical continuum; this, at any rate, is precise and definite. From it we get the concept of a continuous real variable, and thence can proceed to the differential and integral calculus treated by the method of limits. This involves the use of a fluent differential, but there are no serious logical difficulties. Dr. Geissler's attitude is anything but precise, and not always consistent; he appears to try to establish the existence of infinitesimals of different orders as actual entities, and this partly by geometrical considerations. In this region of thought geometrical intuition is wholly untrustworthy; and it is doubtful whether any satisfactory analytical theory can be constructed on the basis of what we may call fixed infinitesimals. It is certain, for instance, that in the arithmetical continuum there is no natural series of orders of infinitesimals. What is the precise nature of geometrical continuity, and how far it can be expressed by arithmetical means, is a very difficult question, upon which Dr. Geissler does not help to shed any light.

One important point the author does emphasise, though sometimes with more zeal than discretion. The terms *infinite* and *infinitesimal* have no precise meaning except in relation to a context and to certain presuppositions. Thus, in projective geometry, the statement that all points at infinity lie in a plane is a convenient summary of a set of facts about parallels; on the other hand, in the theory of algebraic functions, we assume that in the plane of the complex variable there is only a single point (not a line) at infinity. Each statement is true in its context, and out of its context it means nothing at all. If, with Dr. Geissler, we set off equal finite segments continually along a Euclidean straight line, we may assert the possibility of any

number of finite segments at infinity; to enumerate them we require transcendent integers, but there is nothing illogical in the conception, provided that we use it consistently. But we must not criticise one conception by the results of another with which it is radically incompatible.

To show how weak the author's logic is, it is sufficient to refer to his discussion of the old fallacy of Achilles and the tortoise. Here it is established that an indefinite number of successive intervals of time can be found, for each of which the tortoise is ahead; and it is falsely concluded that the sum of these intervals of time tends to an indefinitely long period. Instead of pointing out this simple fact, Dr. Geissler argues that the division of the initial interval between Achilles and the tortoise is illegitimate! ("Man darf sich nicht einbilden, es liege schon im Wesen einer Strecke AB auf ihr in irgend einer Weise Strecken zu tragen.") In fact, his hankering for infinitesimals, in the sense of indivisibles, makes all his treatment of limits and convergence quite unsatisfactory.

It is a matter for real regret that Dr. Geissler has so completely failed to contribute anything of value to the discussion of his subject. The development of mathematics since the time of Kant has surely provided some new material for speculation; how long must we wait for a philosopher competent to deal with it? Even De Morgan failed to appreciate Rowan Hamilton's conception of algebra as the science of pure time; the truth of this idea (except, perhaps, for group-theory) is becoming daily more evident. But while analysis is thus practically reduced to a subjective construction, there are elements in geometry which refuse to be so assimilated. Not all mathematicians are geometers, but those who are will sturdily maintain that, in some sense or other, there are geometrical data which are not expressible in terms of arithmetic. The present tendency towards critical analysis may, we hope, be succeeded by renewed interest in pure geometry. Then, perhaps, something more may be done towards distinguishing its primary axioms.

The analytical doctrine of the infinite has been sketched in a very interesting manner by Dr. Hobson in his recent presidential address to the London Mathematical Society; this deserves to be widely read, because it presents the main discoveries of Dedekind, Cantor, &c., in a form which does not assume any advanced mathematical knowledge on the part of the reader. G. B. M.

PRACTICAL PHYSIOLOGY.

Practical Physiology. By A. P. Beddard, J. S. Edkins, Leonard Hill, J. J. R. Macleod and M. S. Pembrey. Pp. xiv + 495 (London: Edward Arnold, 1902.) Price 15*s.* net.

THE aim of the authors of this text-book has been to provide medical students with a course of physiology which shall not only give them sufficient mental training—practical Chinese or Greek would do this—but also ensure that this training shall be of substantial use in their after medical career. In some respects, this aim has been carried out in an admirable manner. Many of the articles are clearly written and well illustrated, and some of the sections—notably those on circulation, blood gases and physiological optics—contain valuable information not readily accessible to the student in any of the existing text-books. Other parts hardly maintain this high level, and the chapters on muscle and nerve in particular are noticeably deficient, even allowing for the author's expressions of dissent in the preface, and it is curious to see a text-book of 495 pages in which only two are devoted to the description of the galvanometer and capillary electrometer together, and where three lines contain the major part of the information on the electromotive phenomena of the heart!

The book is divided into four parts; the first two of these, comprising the more elementary exercises, are, on the whole, very good. The labour involved in preparing new illustrations and tracings must have been considerable, and the authors are justly to be congratulated on the result of their exertions. In addition to the experimental exercises already noticed, the section on physiological chemistry merits favourable comment, and as a pleasing matter of detail, the drawings of crystals are particularly accurate.

There are certain places, however, which might be subjected to a little revision in the next edition. While the authors reject Von Fleischl's hæmoglobinometer on the ground of inaccuracy, the directions given for the use of the Thoma-Zeiss hæmocytometer will in practice lead all but the very careful student to far more serious errors of estimation. With a little skill, the method for the detection of albuminuria by heat could be carried out so as to show no trace of albumin even when it was present in considerable amount, as acid albuminate would readily be formed under the conditions recommended. "Ethylic acid," on p. 180, is a pretty obvious misprint for "ethyl alcohol." We think that the information on p. 72 is a little out of place, but perhaps this is a matter of opinion.

The "advanced" portion of the text-book is hardly so well written as the "elementary," though the articles on optics and on Haldane's methods for determining oxygen capacity and mass of the blood could hardly be surpassed. Here, moreover, is to be found the largest part of the "comedy of errors" which is inseparable from a first edition. Constantine was an Emperor who reigned at Constantinople; the alloy of manganese and iron used for thermoelectric work was not called after him. The directions for preparing sarcolactic acid, on pp. 442–3, would be improved by the substitution of the word "phosphoric" for "sulphuric," and the method, on p. 426, for decomposing proteids contains more than one serious error, and should be re-written throughout.

But besides these smaller matters, there is an authoritative method adopted of disposing summarily of controversial points by *ex cathedrâ* utterances; we think that a text-book writer might, in a fairly complete work such as this, at least mention the possibility of different views being held by other physiologists, absurd though this may seem to him.

It is a pity that an index was not included in the book;

the few pages that are dignified by the name are merely a mockery to anyone who is not one of the authors.

However, even with these easily remedied defects, the book is a good and useful one which can be recommended to the student as one to be added to his library.

OUR BOOK SHELF.

Studies in the Cartesian Philosophy. By Norman Smith, M.A. Pp. xiv + 276. (London: Macmillan and Co., Ltd; New York: The Macmillan Company, 1902.) Price 5*s*. net.

THE title of Mr. Smith's book conveys an adequate idea of its scope. The author indicates the lines of his treatment thus:—"In Descartes' system, as we have tried to show, there are three fundamental tenets, viz. the doctrine of representative perception, a very peculiar form of rationalism, and the conception of spirit as an active creative agency" (p. 115). The main portion of the book (pp. 1-115) is devoted to Descartes, with appendices on "Arnauld's denial of the doctrine of representative perception" and on Descartes' views of perception, time and consciousness (pp. 115-136). The rest of the book deals with Cartesian principles in Spinoza, Leibniz and Locke, with Hume's criticism and "the transition to Kant."

The author's treatment is lucid throughout; the main lines of criticism are stated clearly, and, on the whole, adequately. This is especially true of the chapters on Descartes and Locke, where the author has allowed himself to treat the subject at greater length. As to Descartes, the author says, "his philosophy of nature I have reserved for further consideration, and in this present volume limit myself, as far as possible, to his metaphysics" (preface, p. vi). His reason for thus dividing the subject is that Descartes' "metaphysical teaching is perverted by principles wholly at variance with his own positive scientific views" (preface, p i.). This point is specially brought out in contrasting Descartes' physical and metaphysical views of motion (pp. 70-71).

With regard to the salient features of Descartes' teaching, Mr. Smith considers that the *cogito ergo sum*, so far from being "the really ultimate element in his system," is "simply one consequence of the doctrine of representative perception which is itself a consequence of his dualistic starting point" (p. 14). The importance of "method" as "not merely an instrument for constructing knowledge" (p. 23) and the relation of method to Descartes' view of intelligence is well brought out; the same may be said of the author's treatment of the deductive mathematical method and its fallacies. In "the proof of the existence of God," Mr. Smith thinks "Descartes' scholasticism came to a height." He rightly treats some of the Cartesian arguments as purely "official" (p. 64). But we cannot say that he is altogether clear upon the relation of the system as a whole to God; it may be disputed whether Descartes ever meant by God "the all-comprehensive absolute reality." Certainly we can recognise the universality of the criterion without identifying the system with its maker. The author's argument is scattered and somewhat divided between what Descartes really meant and what he really said.

The discussion on Locke is an excellent chapter; the treatment of "substance" and "the unknown" may be specially mentioned (v. p. 195). The treatment of Spinoza and Leibniz, though suggestive, is too brief. As the value of this book lies not so much in its originality as in the accurate exposition of certain lines of thought which have dominated modern philosophy, the author should not have allowed the recent works on these philosophers to cramp his own treatment. The section on Berkeley suggests the same criticism. Yet the many good qualities of the book should recommend it to all students of philosophy. It is adequately furnished with references and has a good index. G. S. B.

Die progressive Reduktion der Variabilität und ihre Beziehungen zum Aussterben und zur Entstehung der Arten. By Daniel Rosa, Professor of Zoology in the University of Modena. Authorised Translation from the Italian by Dr. H. Bosshard. Pp. 106. (Jena: Gustav Fischer, 1903, published 1902.) Price 2.50 marks.

PROF. D. ROSA begins his interesting essay by saying that cuttlefishes might envy the obscurity which multitudinous evolutionist-pamphlets—likened to "ink-squirts"—have given to the troubled waters surrounding the rock of the theory of descent; but this somewhat cynical outlook has happily not hindered him from publishing (in 1899) the booklet before us or from having it translated into German by Dr. H. Bosshard. We have both versions of the essay, and, so far as we can judge, the translation is exceedingly well done.

In his first chapter, Rosa pictures organic evolution as a long-drawn-out "substitution process," in the course of which many groups, having reached their acme, give place to others springing from a lower level of the phylogenetic stem and retaining a capacity for abundant and far-reaching variation. As a group becomes more perfect, it tends to nirvana; its variations are reduced in number, or, in any case, in range; and the extinction of "lost races" like Graptolites, Trilobites, Ammonoids, Pterodactyls, &c., is causally associated with a progressive reduction of variation. It has to be admitted, however, that we do not really know much about the scope of variation in the last days of lost races.

In the second chapter, Rosa inquires whether the progressive reduction of specific variations is wholly due to natural selection or in part also to internal organismal conditions. He emphasises two points:—(1) that an organ which disappears in the course of evolution never reappears along that line of descent, that an organ which has become retrogressive never reacquires the capacity of progress; and (2) that in many cases, there is a constancy or fixity in the numerical relations of parts, *e.g.* segments, limbs and digits, from which the type seems quite unable to free itself. These two sets of facts point to a progressive reduction of variability, especially in types towards the ends of the phyletic branches. This theory is corroborated by detailed reference to the limitations which structural and functional differentiation seems to impose upon the variability of tissues and cells. Evolution is dominated by the "law of progressively reduced variability."

The third chapter is less of a unity, for the author has been impelled to speak briefly "de omni re scibili et de quibusdam aliis." Rosa attaches little importance to individual fluctuations; he relies upon general changes or mutations of the idioplasm occurring throughout the species. He has done useful service in indicating the tendency to reduction of variability in highly evolved types; his essay is very interesting and suggestive, pleasantly free from dogmatism or verbal polemics; but we must wait for more detailed data, and admit that "Thatsachen, nicht Ansichten, entscheiden." J. A. T.

Steel Ships: their Construction and Maintenance. A Manual for Shipbuilders, Ship Superintendents, Students and Marine Engineers. By Thomas Watson. Pp. xiv + 290. (London: Charles Griffin and Co., Ltd., 1901.) Price 18*s*. net.

THE title of this work led us to hope that a long-felt want had at length been supplied; but we regret to have to say that on reading it we were disappointed. Mr. Watson does not appear to have the scientific

knowledge or the range of practical experience requisite for the task he has undertaken. He attempts within the narrow limits of eight chapters running to 286 pages—of which one chapter of only sixteen pages is devoted to "maintenance"—to deal with such great subjects as the manufacture of steel and iron; the quality, strength and tests of these materials; the classification of ships and the assignments of their loadlines; the various methods of ship construction; the strength of ships and the stresses to which they are subjected at sea; the types of ships and the construction of typical vessels; the details of construction of ships and their fittings; and the maintenance of ships during their employment at sea. These are all most important subjects, and greatly need adequate treatment by someone who thoroughly understands them and can make them understood by others. Mr. Watson has certainly failed to do what is required.

The various points are treated in this work chiefly with reference to cargo steamers built to Lloyd's rules, and there is little in some of the chapters except what is contained in those rules. The "laying off" of a vessel upon the mould loft floor, and the manner of giving out particulars of the forms of the various parts of the structure to the workmen, is described in two pages, in a general manner that conveys no really useful information. Similarly, the launching arrangements, and the calculations requisite for them, are only glanced at in a very brief and sketchy manner. The subject of bilge keels is dealt with in twenty lines, and the question of how to place these properly in position upon the ship is dismissed with the remark that they "should be placed so as to give the least possible resistance to propulsion." A student would like to have some guide to that position! In dealing with the subject of vibration of steamships, the author recommends, as a provision against it, the strengthening of parts of the structure in and near the engine-room; and he makes no reference to the most important precaution of all—which has been much studied of late by marine engineers—that of designing the engines so as to obtain as perfect a balance as possible of the reciprocating parts.

The chapter upon "Stress and Strength" is very unsatisfactory, owing to an apparent want of scientific grasp of this difficult and intricate subject. We hope that the "shipbuilders, ship superintendents, students and marine engineers" for whom this work is said to be intended will soon be supplied with fuller and more exact information than is here presented to them.

Elementi di Geografia Fisica, Fisica Terrestre e Meteorologia, ad uso delle Scuole Classiche, Tecniche, Normali ed Agrarie. By Prof. Francesco Porro. Pp. viii + 280. (Turin, Rome, &c.; G. B. Paravia & Co., 1902.)

PROF. PORRO dedicates his little book "a mio figlio Giannino," a distinct novelty in school-book prefaces. The book itself devotes more space to the atmosphere, the oceans and glaciers than is usual in elementary works on physical geography. The features of the land are dealt with in much less detail, while the usual introduction on astronomical matters one expects to find in an English school book of the kind, and the usual appendix on biological matters, are omitted altogether. The result is that it is possible, in a limited space, to give a very satisfactory outline of the departments which are selected for treatment.

Prof. Porro writes as a lover of nature, with a subdued enthusiasm that should prove contagious. He has a good knowledge of the literature of his subject, makes his references accurate, and knows how to choose really instructive photographs and to construct helpful diagrams as illustrations.

H. R. M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cambridge Mathematics.

PROF. GREENHILL'S notice (p. 338) of the German translation of my "Calculus" is pleasant enough reading. He says I follow the method of Squeers, "Spell winder! Now go and clean it." He is nearly right, but in truth I act on the belief that the average English boy loves to learn by doing things first and thinking about them afterwards, and so my method is rather the reverse of that of Squeers. Again, "the book, as a series of events connected by a slight thread of continuous theory, suggests a mathematical Pickwick." This is acute and severe and good humoured and kindly. I hope that Cambridge men, as they believe in Prof. Greenhill's great knowledge and good sense, will also see his kindly feeling, and that they will not think me presumptuous in urging them to consider his advice seriously. It will be gathered that I do not myself think that my course of mathematics for engineers is more than a promising effort. I am very much alive to its defects. But I know that the idea on which I have been working is a good one; I carefully developed that idea in opening the discussion at the Glasgow British Association meeting (published by Messrs. Macmillan). It is an idea as well known as the commonest copy-book maxim, but it is as much ignored at our colleges and schools as the sixth and eighth Commandments were in Blackbeard's ship. Anyone who studies how Prof. Forsyth has transformed my copy-book-maxim-ideas of elementary mathematics teaching so that they have become acceptable to all the schoolmasters of the country, and have in a few months been adopted by many examining bodies, must see that it is useless for anybody outside Cambridge to do more than say more and more strongly and persistently how much Cambridge is ignoring certain obvious truths; how Cambridge is neglecting its duty of leadership of this country in mathematics teaching.

I have pointed out how the engineer needs mathematics in all his work; how he needs the ideas of the infinitesimal calculus, and yet how mathematical symbols have been made hateful to him, his very desire for mathematical knowledge having in many cases been taken a devilish advantage of by self-sufficient dull pedants. How the engineer, clear-eyed and eager to use tools which he knows by trial will never fail him, and scornful of all method which he has by trial found to be mere pretence, has got to loathe mathematics and theory;—is it not written in the pages of every engineering journal that is published? And yet we know that all engineering is built upon mathematics, that all great advances in engineering are made by those practical engineers who accidentally become able to compute, to use the more celestial weapon. When, as at the Royal College of Science, there is an endeavour made to construct a syllabus suitable for the mathematical instruction, not merely of the average, but also of the highest kind of engineer and physicist, the necessity for making sacrifice and obeisance to outside standards well-nigh defeats our efforts. We ask Cambridge to help us towards that freedom without which there can be no true education.

Cambridge leads England in mathematics, and she is at present very far, not only from my ideal of leadership, but also from the ideal of Prof. Greenhill, who knows the state of the mathematical world many times better than I do. I ask Cambridge men, our best mathematicians, the men

without whom nothing can be done, the men whom we all admire so much that we almost forget their faults—I ask them to translate our poor ideas, our platitudes, our truisms, our copy-book maxims as to what ought to be done, into actual performance. The wonderful papers or books that they are now writing, can these make their names glorious for more than fifty or a hundred or a few hundreds of years? Is this fame to be weighed against the greater reward we offer? They have the chance of causing mathematics to be made a mental tool always ready for use by the engineer and physicist, the pioneers of thought and civilisation in this stage of the world's history. We ask them to take a high view of the value of their opportunities; really to lead the vanguard in the attack now at last being organised against the general ignorance of our people.

Let them think of all the university colleges and engineering schools of the country, and consider how disgust at useless routine has led to general neglect of duty in teacher and taught. I know of a college where two senior wranglers in succession have taken charge of the education of the average student, and there has been no teaching of mathematics for many years. I know of another college where another senior wrangler does his best to maintain the old tradition that a man paid to teach ought to know nothing of teaching, ought to care nothing for teaching, and ought to feel insulted if the persons who pay him his salary happen to mention efficiency of teaching in his presence. I acknowledge that these professors are of the salt of the earth; they have done great service to science by their own work; they ought to be encouraged to do more and more of the work that they are specially fitted to perform, but I do say that it is a shame to sacrifice all their students because it happens that Cambridge has not enough endowment for such men. Fifty years ago it did not matter to us if 90 per cent. of the undergraduates at Cambridge made fun of mathematics. It matters to us now very much indeed that the most important weapon that any modern nation can have, the power to compute, should be jeered at by the very men, the engineers, who could make most use of it if they only knew how. This is my excuse for what seems a great presumption in criticising Cambridge and in asking that my ideas shall have a careful consideration. I want to see schemes drawn up for the education of all kinds of civil and military engineers. The courses of study must be made interesting and useful. I do not wish to find that a sailor who has worked out all Napier's and Gauss's analogies has never measured a distance with a tape line on a terrestrial globe, or that he cannot do "the day's work," as it is called, without using seven or six figure logarithms.

It is surely an awful thing that many earnest men, because they have faith in us, should be induced to spend years in making ropes of sand. At the end of long academic courses an examiner finds the best students to be quite satisfied with sand-rope making, and mathematics will be as much detached from their professional work as the game of patience is detached from the daily avocation of the lady who plays it. As for the average men who hate the whole thing, they are better off; I mean, of course, if they manage to pass their examinations, for they can look before and after, and need not pine for what they never had.

The nation feels that its common sense has been outraged, and it is not merely elementary education that is going into the melting-pot. Is Cambridge going to hold aloof from the little army of men who think that the melting and solidifying processes need to be guided? Has Cambridge no interest whatsoever in the nature of the possible crystallisation?

There is no great engineering school the mathematics of which ought not to be in charge of as fine a mathematician as a salary of 1500*l.* or 2000*l.* a year can tempt; is this man to be a Cambridge man?

Let Cambridge make no mistake as to the issue now before us. We know she can do what we want if she likes to set herself to it, and we are willing to coax her, for we owe her much. We shall take care that her very highest ideals are not interfered with; if she makes mathematics popular, pleasant and useful to practical people, she will receive back again such great pupils in pure and applied mathematics as she does not dream of now.

John Perry.

Radio-activity of Ordinary Materials.

In connection with Mr. Strutt's article on this subject in this week's Nature, I may mention that I have received for publication from Prof. McClennam and Mr. Burton, of the University of Toronto, the manuscript of a paper read before the American Physical Society in December last, on the saturation current in cylinders of the same size but of different materials. The cylinders used were 25 cm. in diameter, and were made of zinc, tin and lead; the current in the lead cylinder was about twice that in the zinc, and about 50 per cent. greater than in the tin. The authors found that the current in the cylinders was considerably reduced by immersing the cylinders in a large cistern full of water, indicating that part of the ionisation is due to very penetrating radiation which gets through the sides of the cylinder. I may take this opportunity of stating that I have found that lead apparently gives off an emanation similar to that emitted by radium, for if lead acetate or lead nitrate be dissolved in distilled water, and air very slowly bubbled through the solution, the air coming out has greater conductivity than if it had been bubbled through the distilled water alone, and it retains this additional conductivity for many hours. We hope to investigate the effect of other metals in solutions and to determine whether or not it is due to the radio-active impurities in the salts.

J. J. Thomson.

Cavendish Laboratory, Cambridge, February 21.

Fall of Coloured Dust on February 22–23.

I have received this morning from two of the observers of the Royal Meteorological Society samples of red or muddy rain which fell on Sunday night or Monday morning.

Mr. C. Grover, of the Rousdon Observatory, Devon, on Monday morning, February 23, found that the windward sides of the thermometer screens were conspicuously marked with a deposit of reddish or rusty coloured mud, so thick as to attract attention at once. There was the same appearance on the anemometer tower—the window ledges, the iron ladder and the white painted wooden shelf thirty feet above the ground being all marked with the same deposit. The rainfall was only 0·02 inch.

Mr. J. W. Phillips, of Haverfordwest, says that rain fell between 6 and 9 a.m. on Monday, and that when the rain gauge was examined the water was found to have a sediment of dust. The quantity of rain measured was 0·31 inch. Mr. Phillips says that the phenomenon has been noticed in other parts of the country.

The deposit at Rousdon was apparently much thicker than at Haverfordwest. The fall must have extended over a wide area.

Wm. Marriott.

Royal Meteorological Society, S.W., February 24.

Chapman's Zebra.

In the course of some studies of the genus Equus, I obtained a number of measurements of the skulls of zebras and quaggas through the kindness of Mr. J. A. G. Rehn. The measurements were based on specimens contained in the collection of the Philadelphia Academy of Natural Sciences. Upon comparing these data, I found that the measurements for *Equus chapmani* did not approach most nearly those of *E. burchelli*, of which *chapmani* is supposed to be a variety. Roughly speaking, if the resemblance to *burchelli* were expressed by 4, that to *E. zebra* would be expressed by 6, that to *E. grevyi* by 3, and that to *E. quagga* by 1.[1] In particular, *E. zebra* and *chapmani* had the zygomatic breadth and the breadth between the orbits above much less than in *burchelli*. The specimen of *chapmani* was said to be from Zanzibar. Part of the facts observed may be due to immaturity, and Mr. Oldfield Thomas warns me that the precise identification of *E. chapmani* is a matter of doubt; but from what I have been able to learn, it seems not impossible that *E. chapmani*, as represented by Prof. Ewart's "Matopo," may be a valid species. As it is quite out of the question for me to settle this matter, I venture to commend it to such of your readers as have better opportunities.

T. D. A. Cockerell.

East Las Vegas, N.M., U.S.A., January 23.

[1] These figures are based, not on the absolute measurements, but on the measurements expressed in percentages of the total length of the skull.

AMERICAN MAGICAL CEREMONIES.

THE Dwamish Indians of Cedar River, Washington Co., U.S.A., believe that when a man is seriously ill in the winter his spirit departs to the under-world, which is an exceedingly attractive place in cold weather. It is only at that season that the spirit of a sick man leaves the body for the nether world; during the summer-time, the spirit travels from place to place on earth, and even when a man dies in the summer his spirit waits until the winter is well advanced before it retires under-ground. One of the favourite methods in the summer of compelling the spirit of a sick man to return to the body is by singing, but in the winter, the spirits of the officiating shamans have to journey to the under-world in order to bring back the recalcitrant spirit, and even they find it hard to tear themselves away from the pleasant home of the dead.

The ceremony takes place in the dance-house. A rectangular space, measuring about 10 feet by 20 feet, is marked off by vertical slabs. This is called the canoe, and inside are placed, in an upright position, small painted human effigies; these very materially assist the shamans to compel the spirit to return. The shamans, each of whom has a long pole, enter the canoe and begin by singing, which is accompanied by the beating of rattles and drums by the friends of the invalid; at the same time, the shamans make paddling movements with the poles. This is kept up all night; by noon of the next day, they are supposed to have entered the under-world, where the struggle for the possession of the spirit of the sick man begins and lasts for a day and a half. At the end of the fourth day, one of the shamans intimates to the friends of the sick man that they have been successful, and, as a matter of fact, in the instance specified the sick man mended speedily.

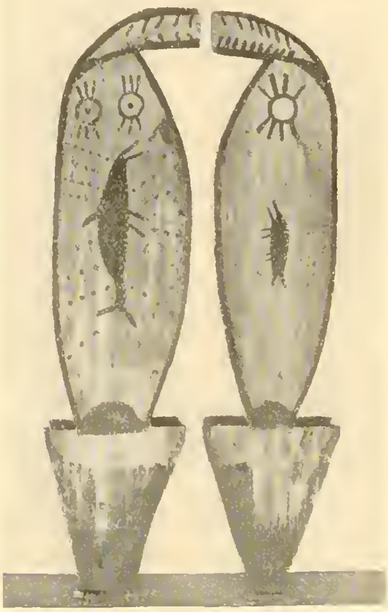


FIG. 1.—Painted slabs of wood for sides of spirit boat.

Two of the painted boards that form the spirit boat are shown in the accompanying figure; the snout-like projection and a single eye, or a pair of eyes, are on all of them, but the decoration of the body of each board varies. In the first figure, a cetacean is drawn, and the shape of each board suggests that it is also a cetacean. Dr. G. A. Dorsey's account of this ceremony is the first that has been published, and as it is now almost extinct, it is fortunate that he was able to record this vanishing magical rite. The paper from which this abstract was taken was published, along with other original articles and various notes of ethnographical interest, in vol. iii. of the *Bulletin* of the Free Museum of Science and Art of the University of Pennsylvania.

Also to Dr. Dorsey, but in this case in collaboration with Mr. H. R. Voth, are we indebted for a very interesting and exceedingly well illustrated account of the Soyal ceremony of the Oraibi, one of the six Hopi villages in Arizona. On the first day of the ritual, feather standards are erected, cornmeal is spread over them, and a small pinch of the meal is thrown towards the rising sun. The performers smoke ceremonially during the whole day, and card and spin cotton. The second and third days are employed in a similar manner. On the fourth day, various sacred objects are exhibited and certain feathers are provided. These are tied on sticks to construct what are termed *bahos*; the *bahos* are prayed and smoked over, and holy water is obtained from a spring; nine songs are sung at ceremonies which combine prayer with the offering of cornmeal. On the fifth and three following days, the people fast. A considerable part of the fifth day is spent in practising various *katcina* dances. The Hawk priest screeches and performs most fatiguing dances. On the sixth day, the rite of offering cornmeal to the dawn is again performed; there are no important ceremonies on this day, but many preparations are made. All the men begin the seventh day by making prayer offerings (*bahos*) and objects composed of maize husks, to which feathers are fastened; these are termed *hihikwispi*, or "something breathed upon." On the following day, each performer takes his *hihikwispi*, holds it to the rising sun and says, "I breathe on this"; he then runs to his house, where all breathe on it, and so the *hihikwispi* are carried from house to house; this ceremony is a charm for the protection against sickness of the respiratory organs. Later a shrine is decorated before which smoke is "planted," and rain clouds are represented by six black semicircles; a fertility ceremony is performed before, and more particularly after, the fetching of water from a spring. Masks are worn

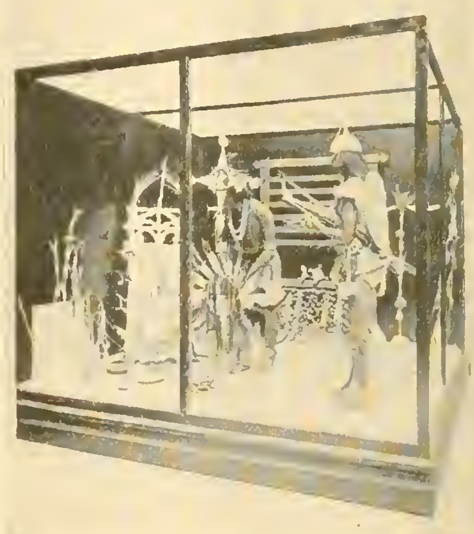


FIG. 2.—Case in the Field Columbian Museum illustrating the Soyal altar and the sun ritual.

on this day; again there are bird dances, which keep on all through the night. Before daybreak on the following morning, the climax of the whole ceremony is reached; in front of the fire which burns before several altars, the Star priest twirls a sun symbol and is sprinkled with sacred water from a medicine bowl by the priest who represents the War-god; later in the day, the *bahos*, or prayer sticks, are deposited in various shrines around the villages. The four subsequent days are spent in rabbit hunting, and a big feast concludes the ritual.

Dr. Dorsey and Mr. Voth have wisely published a detailed account of what takes place, but their descriptions would have been of greater value to students of comparative religion if more explanation had been given as to the significance of the various rites. It is obvious that the details described are full of symbolism, the meaning of some of which can be readily guessed, but we do not want to make guesses, we need to be told definitely what the natives themselves understand by their rites. This memoir appears in vol. iii. of the Anthropological Series of the publications of the Field Columbian Museum of Chicago.

FIG. 3.—Katcina dancing on a sand picture in front of the candidates for initiation into the Powamu fraternity.

Following this is a memoir, by Mr. H. R. Voth, on the Oraibi Powamu ceremony. Mr. Voth has been for many years a missionary to the Hopi, and so has had exceptional facility for studying their customs, and it will be evident he has not wasted his opportunities. One of the items in the preliminary ceremony is a prayer and ritual for the protection of plants and corn against destructive sandstorms. Later the uninitiated boys and girls have their hair cut. Characteristic features of the Powamu ceremony are the making of coloured sand pictures or mosaics and the dancing of masked men, *katcinas* (Fig. 3). An important part of the ceremony consists in the flogging of the boys and girls who are being initiated into the Powamu fraternity; each child has a male and female sponsor, who for ever after are called his or her "father" or "mother"; they are never relatives, nor can they be of the same clan as the actual father and mother of the child, but both must be of the same clan. Before the whipping of the children, an ancient migration saga is narrated. This careful study of a ceremony that is doomed to disappear is illustrated by a large number of well executed plates, which greatly enhance the value of the paper. The extensive collections made by Mr. Voth are in the Field Columbian Museum, and under his direction there have been erected in the museum wonderful cases illustrating Hopi altars and sand pictures, and life-sized models of priests in the act of performing various ceremonies.

Those who wish to study the secular and religious life of the Hopi Pueblo Indians must visit the museum in Chicago, for there they will find very extensive collections well arranged and fully labelled. In all probability, these will be accessible to future students when, in the not far distant time, sacred objects and picturesque ritual will have passed away and become forgotten in their native pueblos.

A. C. H.

THE FATA MORGANA OF THE STRAITS OF MESSINA.

JUST as the Brocken is noted for its "spectre," so the Straits of Messina have long been known as presenting, under certain exceptional atmospheric conditions, a fine display of the appearances known as Fata Morgana. On his appointment in 1899 to the chair of physics at the Technical College of Reggio, Dr. Vittorio E. Boccara undertook a historical and critical study of the phenomena, and the results of his investigation are published in the *Memorie* of the Italian Spectroscopists' Society, xxxi., 10.

Among the ancients, the name of Aristotle is mentioned, but his references to the Fata Morgana are doubtful. Cornelius Agrippa spoke of reflections in the air of mountains, animals and other objects; Homer, Apollonius Polycletus, Damascius and Pliny also alluded to apparitions in the air, but their descriptions are not precise. Allusions to the Fata Morgana are also contained in the historical writings of Tommaso Fazzello (1550), Giuseppe Carnevale (1591) and Marc' Antonio Politi (1617), but the first attempt at a description of the phenomena was given by Father Angelucci in a letter published in 1671 by Athanas Kircher, in which he described the appearances seen on the morning of Assumption Day (August 15), 1634. These effects Kircher attributed to reflection by crystals in the air, and stated that he had been able to reproduce them artificially before a large audience.

In 1773, Father Antonio Minasi published a "dissertation on the phenomenon commonly called Fata Morgana," in which he distinguished hree different forms, namely, marine morgana, aëria. morgana and iridescent morgana. Minasi illustrated his descriptions by a remarkably good drawing showing the three phases.

In a treatise published at Naples in 1824, Captain Pietro Ribaud described the marine morgana of July, 1809, and gave a detailed account of the meteorological conditions necessary for its formation. In addition to calm, hot weather, we notice that Ribaud considered it necessary that the vapours exhaled under the heat of the sun from the heterogeneous substances, antimonious, vitreous, oleaginous, saline and other, contained in quantity in the shores and earths of Calabria and Sicily should not be carried away by the wind. Also the most favourable time for the morgana is about the turn of the tide.

The first to explain the morgana by refraction was Prof. Salvatore Arcovito (1838), who, however, considered the phenomenon similar to parhelia. Cacopardi never saw the morgana himself, but followed the views of Minasi and Kircher. Regaldi saw the phenomenon on

July 20, 1848, and describes how parts of the coast suddenly appeared, standing, so to speak, in the middle of the channel.

Coming to recent times, we have a description in the *Zagàra* for 1871 by an anonymous writer. A white streak of mist passing across the Sicilian coast melted like a transparent veil, revealing arches, towers and colonnades floating on the sea, houses, and woods of many colours.

Not less explicit is Prof. Filippo Capri, who described in the *Zagàra* the Fata Morgana of June 20, 1874, which occurred between 8 and 9 a.m. The weather was so hot as to ruin the crop of bergamot fruit, and the phenomenon, as on other occasions, was preceded by a white mist. Buildings were seen to become elongated, while the shores, with their villas and trees, became detached like islands and then disappeared. In answer to the invitation for an explanation, Dr. Diego Corsa repeated Minasi's erroneous opinions, but this point of view was attacked by Prof. Canale, who, however, did not venture to formulate a theory of his own, having only seen the phenomenon once.

Prof. Boccara speaks from personal knowledge of three displays of the Fata Morgana under its three different

FIG. 1.

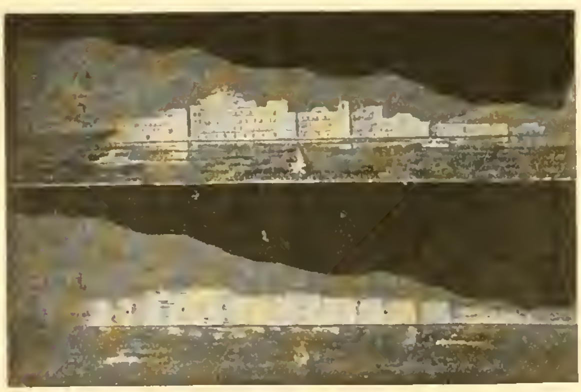


FIG. 2.

FIG. 1.—Aërial Morgana of June 27, 1900.
FIG. 2 shows the white mist just before the commencement of the phenomenon.

forms—namely, an aërial morgana on June 27, 1900, witnessed by himself, Captain Vincenzo Ponzi, of Chiaggia, and Prof. Enrico Puccini; a marine morgana on July 2, 1901, also seen by Prof. Puccini; and a multiple morgana on March 26, 1902. The first is well shown by the author's sketch in Fig. 1, Fig. 2 giving an idea of the white mist seen just before the occurrence of the phenomenon, and which disappeared when the occurrence took place. In it, the houses on the Italian coast at Gallico and the point of Catona are seen to be considerably elongated in a vertical direction, and, so to speak, projected on the Sicilian coast beyond, the straits appearing to be converted into a gulf. In the marine morgana of 1901, a cloud again formed just previously, and the appearance was presented of arches standing below the sea line in an upright position, their bases having no visible foundation. These arches corresponded to some railway arches above the cemetery of Messina, but were more brilliant and larger than the real arches. Of the third or multiple morgana, Prof. Boccara has given an illustration in Fig. 3, which, however, represents simultaneously various phases of the phenomena which were in reality seen in succession. Thus the three houses at the left were not all visible at the same instant; when one appeared, the other disappeared. The white band with vertical dark stripes was attributed to the wall of the citadel at Messina, and it appeared to blot out the houses of the town.

Prof. Boccara attributes all these phenomena to variations in atmospheric density, which produce refraction effects. It may be suggested to the mathematician that consideration of the principle of least time for the path of a light ray affords an easier way of thinking of the conditions necessary for the phenomenon than is given by the sine law of refraction. The term Fata Morgana is used by the author exclusively in connection with apparitions in which the images are erect. When inversion takes place, so that the phenomena are due to reflection, the effect is a mirage, a phenomenon also seen not unfrequently on the Sicilian coast.

The neighbourhood of Reggio is peculiarly adapted to the display of the Fata Morgana both by its topographical peculiarities and by the meteorological conditions not unfrequently existing there These conditions are, a morning hour, hot weather, extreme clearness of the air, combined, however, with a thin veil of mist over the Sicilian coast, and a calm air or slight wind from the north, as conditions for the marine morgana. For the aërial morgana, the best time of day is from 10 a.m. to 1 p.m., with a stratum of light cloud on the coast of Sicily, sea calm or nearly so, a high temperature and

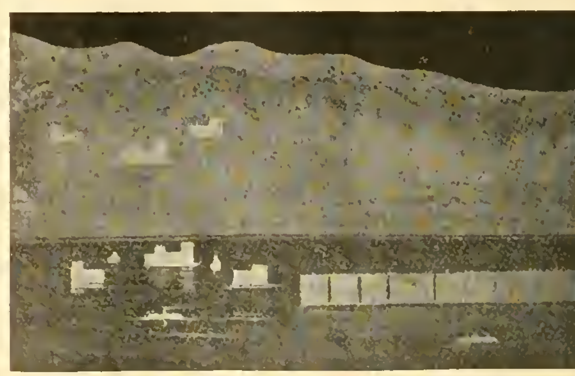


FIG. 3.—Multiple Morgana of March 26, 1902.

wind as before. A multiple morgana is, of course, of much rarer occurrence than the simple form, and the one seen in March, 1902, was less marked than one observed about twenty years previously by Prof. Scerbo and Signor Aloi, of which a sketch is reproduced in Dr. Boccara's paper.

G. H. B.

INDIAN RAINFALL.

EVERYONE acquainted with the rainfall statistics of India is familiar with the appendix to the third volume of the *Indian Meteorological Memoirs*, which was published in the year 1888, when Mr. H. T. Blanford was Meteorological Reporter to the Indian Government. This appendix contained the monthly and yearly rainfalls for each station which possessed a rain-gauge, and the period over which the observations extended was in some cases, such as Bombay, Madras and Calcutta, very long, the last year in which the observations from all stations were included being that of 1886.

Since that epoch many years have passed, and the time had evidently arrived for this volume to be brought up to date and the whole mass of useful rainfall data collected together under one cover. We are glad to say that this large piece of work has now been completed and published (1902), and forms the fourteenth volume of the *Memoirs*.

Under the able editorship of the present Meteorological Reporter and Director-General of Indian Observatories, Sir John Eliot, this new volume contains all the available data up to, and including, the year 1900, and it is to this volume that inquirers of Indian rainfall statistics will now turn. Several minor changes will be found to have been made in the tables, such as zero (0) instead of (. . .) when no rain had fallen during a month, the authorised orthography, &c., but the most valuable addition is undoubtedly the insertion of two extra columns for each station giving the total rainfall for each monsoon.

India, as most people know, receives its rain mainly at two periods of the year, namely, during the summer months when the south-west monsoon is blowing, and during the winter months when the north-east monsoon is blowing. In any investigations on the variation of rainfall due to extra-terrestrial origins or involving atmospheric circulation, it is of the greatest importance to be able to treat the monsoon rainfalls separately. Again, some stations are more favourably placed, geographically, to depend chiefly for their yearly rainfall on one or other of the monsoons, or both; thus Bombay's rainfall is entirely due to the south-west monsoon, while the wind which gives Madras its rain is the north-east; further south, in southern India, several of the places are more fortunate, and secure their rains from each monsoon in turn, so that if one monsoon fails them, they still have a chance of obtaining their rain from the other.

In dealing with such a large area of country as is covered by the Indian Meteorological Department, it was found desirable to adopt a grouping of the months for each monsoon that would be general to the whole of India, with the least detriment to some individual areas.

Thus the months finally settled upon were as follows:—N.E. monsoon, December to April; S.W. monsoon, May to November. The two columns, therefore, that are inserted for the first time in this volume show the total rainfall at stations during the five months ending April 30 of the year in question, and the total rainfall of the seven months ending November 30 of that year.

The fact that this volume contains no less than 709 pages and weighs 5lb. 14½oz. in its paper cover, will give the reader some idea of the mass of rainfall statistics it contains and of the labour involved in bringing the information together. The volume should serve as an admirable model for other countries to adopt, and it would be to the advantage, not only of Great Britain and her Colonies, but also of many foreign countries in various parts of the world, to coordinate their rainfall observations in a similar manner, so that such records, which are well worth making, are ready at the hand of any investigator who at the time may be working up the subject.

William J. S. Lockyer.

THE AFFORESTATION OF THE BLACK COUNTRY.

In the spring of 1892, when marking trees for cutting in the Belgian Ardennes (Chateau de Mirwart), I noticed that a portion of the wood, alongside a meadow and a watercourse, had the irregular shape of spoil heaps. On inquiry, I found that some 200 years before iron-smelting had been carried on at the spot, and that the heaps consisted of old slag and other débris, such as may be expected under a rudimentary process of iron-smelting. The heaps were stocked with oak and ash trees, some of them of considerable size and value, others of smaller dimensions. I marked the large trees for sale, leaving all middle-sized and smaller trees. The latter girthed up to 4 feet at 5 feet from the ground, while the trees marked for cutting girthed 6 feet, and even more. I considered this a very interesting case, but as I did, at that time, not know the Black Country, it did not strike me to utilise my experience for the benefit of the English mining districts.

Towards the end of the same year, Mr. W. R. Fisher visited me at Mirwart, and when he saw the above mentioned case, it struck him to apply it to the Black Country. He subsequently visited that locality and urged its afforestation on more than one occasion. The honour of having brought the subject prominently before the public belongs to Mr. Fisher.

I have just read an account of a meeting at Birmingham, presided over by Sir Oliver Lodge, to inaugurate a society for promoting the afforestation of the Black Country. As the result of the meeting, a resolution was carried, a committee was formed, and Mr. Herbert Stone was elected hon. secretary of "The Black Country Tree-planting Society."

The area in question is believed to be 14,000 acres, covered with spoil and ash heaps, on which now some grass grows; it is grazed over by sheep. Sir Oliver Lodge, quite correctly, brought the probable financial results of afforestation into the foreground, while some of the other speakers referred to the importance of a sylvan environment for moral, hygienic, and æsthetic considerations, leaving the financial aspect to take care of itself. This I consider a mistake, because, with the best intentions, humanitarian considerations alone are not likely to achieve the object in view; besides, they can very well be realised, alongside of good financial results.

The area in question belongs, I understand, to a number of different proprietors, and this alone would probably be a great hindrance to bringing the undertaking to a successful issue. In my opinion, the adjoining municipalities, such as Birmingham, Dudley, Bilston, Wolverhampton, Darlaston, Wednesbury, Oldbury, &c., should put their heads together, devise a plan of acquiring the land in question, which cannot be of much value, and create a joint municipal forest estate, to be managed by one man. This manager might be made responsible to a joint committee, and under its orders carry out the afforestation of the area on a well-considered plan. In that case, æsthetic considerations can receive full attention, while the woods should be so laid out, as to species, &c., that a reasonable return on the outlay may be expected.

If the plan here sketched should prove to be impracticable, it would be quite worth while for the State to acquire the land and plant it up. In any case, a well-considered plan of action as regards the manner of afforestation, the species to be planted, &c., is a *sine qua non* of ultimate success, and the drawing up of such a plan should be entrusted to an expert, who is fully conversant with the management, and more especially the financial management, of forest estates. I lay stress on this, because I see it stated that sycamore, ash, lime, beech and poplar should be planted. There will, no doubt, be many places where these trees can be introduced, but the bulk of the area should be stocked with fast-growing conifers, the thinnings of which will, at an early age, give large quantities of pit timber, and thus secure favourable financial results.

W. Schlich.

NOTES.

IN several districts of the south of England and Wales, coloured dust or sand accompanied a fall of rain on Sunday last, February 22. At Etchingham (Sussex), twelve miles from the sea, particles of dust deposited by the raindrops were left on the trees. At Swansea and other places in South Wales the puddles left by the rain were reddish in colour. Mr. A. E. Brunsden, the piermaster at Swanage, Dorset, noticed that a thick fog which occurred with the rain on Sunday morning had a peculiar yellowish tinge. On Monday morning the ironwork on the pier was found to be covered with a fine, salmon-coloured dust. Some specimens of dust collected after the fall have been sent to us by Mrs. Neville Ward, and are being examined.

IN reply to a question referring to afforestation in Ireland, Mr. Wyndham remarked in the House of Commons on Tuesday "Some of the recommendations in the report of the Committee on British Forestry are applicable, in principle, to Ireland. The Irish Department is at present conducting a special survey of existing woodlands and lands suitable for forestry operations. Such a survey is necessary to enable the Department to consider the measures to be adopted to give effect to the recommendations of the report in question."

DR. C. W. ANDREWS, of the British Museum, has arrived in Cairo, and started for the Fayum Desert, where, in conjunction with the officers of the Egyptian Geological Survey, it is hoped that he may be able to add largely to the collection of Eocene vertebrate remains from that district.

THE anniversary meeting of the Geological Society was held at Burlington House on Friday, February 20. The medals and funds, of which the awards have already been announced, (p. 250) were presented. The president delivered his anniversary address, which dealt with the relations of geology to its fellow-sciences.

REUTER reports that the following telegram from Honolulu has been received at San Francisco:—"Mr. Schroeder, Governor of Guam, Ladrones Archipelago, is here on his way home. He reports the occurrence of a severe and prolonged series of earthquakes, accompanied by loud rumblings, which have raised the level of the island by six inches."

AT the annual general meeting of the Physical Society on February 13, Dr. R. T. Glazebrook, F.R.S., was elected president for the ensuing year. Mr. H. M. Elder has found it necessary to resign the office of secretary, and Mr. W. R. Cooper has been appointed his successor. In the course of an address delivered upon taking the presidential chair, Dr. Glazebrook said that the Society should have a wider range of activity, and technical papers should not necessarily be excluded. Interest might also be aroused by arranging at times for set discussions. Attempts should be made to give advice and guidance to physicists in isolated positions about the country having time to carry out research. The address also dealt with the history of theoretical optics during the last sixty years, and the part taken by the late Sir George G. Stokes in its development.

AT the meeting of the Royal Astronomical Society on February 13, the Society's gold medal was awarded to Prof. Hermann Struve, director of the Königsberg Observatory, for his work on the satellites of Saturn, published in 1898 in the publications of the Central Nicolas Observatory, Pulkowa. Prof. Turner delivered an address describing the long series of observations and the complex and laborious calculations by which Prof. Struve had determined the motions and masses of the satellites, the position of the equator of Saturn, the compression of the body of the planet, the mass of the ring, &c. The address concluded with a mention of the fact that half a century ago the gold medal had been awarded to Prof. Struve's grandfather, and a quarter of a century ago to his father, who still lives, one of the Society's oldest associates. At the conclusion of the address the chairman handed the medal to Count von Bernstorff, Councillor of the German Legation, for transmission to the medallist.

THE annual general meeting of the Institution of Mechanical Engineers was held on February 20, when the annual report of the council was presented. The report points out that the completion of his sixth report to the alloys research committee has been delayed by the death of Sir William Roberts-Austen, but a large amount of his experimental work, dealing with the tempering of steel, and also with alloys of the industrial metals, is available, and is now being dealt with by the committee. No further report will be made by the gas-engine research committee until the large experimental engine has been put to work at the Birmingham University. Prof. T. Hudson Beare has been occupied at the University of Edinburgh in perfecting the apparatus for testing the value of the steam-jacket. Prof. David S. Capper has now concluded his experiments at King's College upon jacketed and unjacketed steam cylinders, and a report upon his comprehensive experiments is almost completed. The question of the standardisation of flanges has received the attention of the council, and was dealt with at the April meeting in a paper by Mr. R. E. Atkinson. A considerable number of members and others have since sent in contributions bearing on the best forms to be adopted as standards. The engineering standards committee, the constitution of which was explained in the last annual report, has held frequent meetings during the year, and its recommendations relating to standard sizes for rolled sections will be published shortly.

MR. HANBURY, Minister of Agriculture, addressing the Lancashire Farmers' Association at Preston on February 21, said he understood that the Department of Fisheries was to be added to the Board of Agriculture.

DR. DEMPWOLFF, who succeeded Prof. Koch as head of the German expedition for the investigation of malaria in German New Guinea, states, according to the Berlin correspondent of the *Standard*, that he has discovered an aquatic insect which destroys the Anopheles mosquito. He proposes to cultivate these insects by artificial means, and in this way hopes to exterminate the malaria mosquito.

THE French Chamber of Deputies has recently adopted a Bill intended to create a nickel coin in France. *La Nature* states that to prevent confusion with the silver franc the new nickel coin of 25 centimes will weigh seven as against the five grammes of the franc; the edge of the nickel coin will not be fluted like the silver franc; the new coin will be half as thick again as the franc. At first 16 million pieces will be struck off, and this will require 112,000 kilograms of nickel.

THE "Life and Letters of Thomas Henry Huxley," by his son, Mr. Leonard Huxley, first published by Messrs. Macmillan and Co., Ltd., in 1900, and reviewed by Sir W. T. Thiselton-Dyer, K.C.M.G., in NATURE for June 13, 1901, has been reissued in three volumes in the well-known "Eversley" series at 12*s*. net. The opportunity afforded by the publication of a second edition has been taken to correct various misprints, and to rectify a few errors and omissions in the first edition. In its cheaper form the book is sure to renew its popularity, and to reach a wider circle of Huxley's admirers.

THE Royal Academy of Sciences of Turin announces that one of the Vallauri prizes will be awarded by the Academy to the man of science, without distinction of nationality, who, from January 1, 1907, to December 31, 1910, shall have published the most important and most celebrated work in the domain of the physical sciences—these words being used in their broadest sense. The amount of the prize is 30,000 Italian pounds net. The prize will be awarded a year after the result has been announced. Works submitted to the Academy will not be returned, and manuscripts will not be considered.

SPEAKING at Dorchester on Monday, at the opening of a new operating theatre, Sir Frederick Treves said that the ceremony that day represented a movement the magnitude of which it was not at first easy to appreciate. Twenty-five years ago that part of surgery which dealt with operations was more or less discredited. It was singularly disappointing and, he was sorry to say, singularly unsuccessful. The amount of work that was then done through operations was comparatively small. The great development that had taken place was all due to the introduction, by Lord Lister, of antiseptic surgery, which had rendered operative treatment possible. The result had been the saving of many thousands of lives annually, and the rescue of still more thousands from a state of hopeless illness. The performance of important operative surgery was no longer limited to London and a few great cities; operative surgery had spread all over the country, and now nearly every provincial hospital had its own operating theatre. It was all part of a general movement which would result in bringing medical and surgical science to a higher level than had ever before been attained in this country.

THE *Natal Mercury* of January 9 last states that a meteorological institute has been established at Bloemfontein. Substations are being started in Harrismith, Kroonstad, Heilbron, Bethlehem and Bethulie, and records from all points will be sent to Bloemfontein. Observations taken so far promise very interesting study, and show remarkable variations of conditions throughout the Orange River Colony, both as regards one part in relation to others, and in daily changes at some stations. Such systematic study of meteorological conditions as this will very soon be of practical benefit to agriculture in this colony.

A REUTER message from St. Petersburg states that the Imperial Academy of Science has decided to dispatch an expedition to search for Baron Toll, who left Siberia in June last with a few companions to explore Bennett Island, and has not been heard of since. The search expedition, which will be headed by Lieutenant Koltchak, who was with Baron Toll before he left the Siberian coast, will proceed shortly to New Siberia and, if necessary, to Bennett Island, as there is reason to believe that the baron, seeing his road back to New Siberia cut off by the breaking up of the ice towards the middle of July last, remained in the island to pass the winter.

THE New York correspondent of the *Daily Mail* reports that the first detailed announcement of the plans of the Rockefeller Institute, founded by Mr. John D. Rockefeller with an endowment of 40,000*l*. two years ago, has been made public. Mr. Rockefeller added 200,000*l*. to the endowment last summer. It is expected that his contributions will ultimately reach a total of two and a half million pounds. Mr. Simon Flexner, of the University of Pennsylvania, has been chosen to take charge of the work, which will be centred in New York. A research laboratory will be opened in October. Then will follow a hospital, where special groups of patients will be treated in order to develop new methods of practice. The programme also includes the publication of a journal of experimental medicine and the creation of a popular hygienic museum. Several physicians have already been sent to Europe to make special researches.

THE Savage Club entertained Mr. Marconi on Saturday evening, February 21. Mr. Henniker Heaton, M.P., occupied the chair, and among the visitors were the Marquis of Dufferin and Ava, the Earl of Malmesbury and Sir Charles Boxall. In responding to the toast of his health, Mr. Marconi said he demurred to the statement of the chairman that he had been neglected in England. Like the King of Italy, the King of England had been most kind to him, and for three weeks he, by desire of His Majesty, carried on experiments in His Majesty's yacht *Osborne* which greatly advanced the development of wireless telegraphy. He then traced his work and the opposition he had met with, step by step, from the cable companies. The Canadian Government had given him substantial assistance and a grant of money to carry on his work. The Italian Government had just passed a Bill to erect the largest Marconi wireless telegraph station in the world, to communicate with America. In conclusion, he made the announcement that he had just made an arrangement with a great daily newspaper in London to supply it with a wireless message every day from Canada.

THE Postmaster-General, in reply to a question on wireless telegraphy put by Mr. H. Samuel last Thursday, stated that the effect of recent progress on the commercial and strategic interests of the country was receiving careful attention, and that he was in communication with the Marconi Wireless Telegraph Co. on the subject of its relations with the Post Office. "I am not at present in a position," he added, "to make any final statement on the subject, but I have no doubt it will be possible to secure for the public of this country the use of this method of communication when it is sufficiently developed for commercial purposes." Contrast with this the attitude of the Italian Government, which has just passed a Bill for establishing a powerful wireless telegraphic station in Rome, which was introduced by the Minister of Posts and Telegraphs. The Senate passed a resolution expressing its great satisfaction with the statement of the Minister, and conveying congratulations to Mr. Marconi. It is proposed to make this new station the largest yet built, and it is hoped by its means to establish communication with Argentina and with all the existing long-distance stations.

A NEW form of electric heating apparatus has been invented by Mr. E. G. Rivers, of H.M. Office of Works. The radiator is constructed of a layer of finely powdered retort carbon held between enamelled iron plates and kept in position by asbestos cardboard. Three copper strips are led in, one at the centre and one at each end, and continuous current passed from the centre strip to the outer two. The current taken is about eight amperes at 200 volts, and with this a heating surface of 25 square feet can be maintained at an average temperature of 190° F. The manufacture of this radiator is, we understand, to be undertaken by the Electric and Ordnance Accessories Co., of Birmingham.

ACCORDING to last week's *Daily Mail*, the sharp frost in New York produced some startling effects on the elevated electric railway. There had been rain before the frost, as a result of which the centre rail had become coated with ice, and this led to sparking on a large scale. The effect appears to have been somewhat extraordinary if we may judge from the account given by the *Daily Mail's* correspondent, who writes as follows:—"Dazzling flashes of flame shot high into the air, the reflection in the sky strongly

resembling the Aurora Borealis. Every train resembled a blazing comet, being followed by a long stream of flame and sparks. The whole line glistened with beautiful electrical discharges. Thousands of persons walked the streets watching the strange spectacle." This seems to open out fresh possibilities for electric railways in catering for the public.

THE preliminary account of the international balloon ascents of December 4, published by Dr. Hergesell, show that France, Germany, Austria, Italy, Russia and the United States (Blue Hill) took part in the experiments. Both manned and unmanned balloons and kites were used; the highest altitudes attained were:—Itteville (near Paris), 14,823 metres, lowest temperature $-52^{\circ}\cdot9$ C., temperature on the ground $-4^{\circ}\cdot8$; Strassburg, 16,500 metres, minimum temperature $-65^{\circ}\cdot2$, on the ground $-7^{\circ}\cdot8$; Berlin, 14,465 metres, temperature -35°, on the ground $-11^{\circ}\cdot5$, the lowest temperature was $-46^{\circ}\cdot7$ at an altitude of 9670 metres; Pavlovsk, 17,700 metres, the lowest temperature was recorded at 11,220 metres, $-63^{\circ}\cdot5$, on the ground $-20^{\circ}\cdot7$; at Blue Hill the wind was not strong enough to raise the kite higher than 1100 metres; an inversion of temperature occurred at the height of 1000 metres. The European ascents were made in an area of high barometric pressure.

Symons's Meteorological Magazine for February contains the first of a proposed series of articles on the Canadian climate, by Mr. R. F. Stupart, director of the Meteorological Service of Canada. These articles bid fair to be of considerable interest, and will dispel the popular idea that Canada is an exceedingly cold country. Ordinary readers may not at first realise that a large portion of Ontario lies as far south as the south of France, that Toronto is further south than Florence, and that the southern point of Ontario is further south than Rome. Referring to Vancouver, the author points out that the rainfall along the exposed western coast exceeds 100 inches, but in the more eastern districts it is less than half that amount. "The mean monthly and annual temperatures correspond very closely with those found in parts of England; the summers are quite as long, and severe frost scarcely ever occurs." Crossing to the mainland, about 70 miles from Vancouver, the observations taken at an experimental farm give the mean temperature of January as 33°, and of July 64°; the lowest temperature on record is -13°, and the highest 97°. Further eastward the summers are warmer and the winters are colder, but bright, dry weather is the rule. In the prairie country the winters are at times very cold, but the air being dry, a temperature of -20° causes no inconvenience to ordinary daily avocations, and early in May the prairies are carpeted with flowers.

MR. L. H. MURDOCH describes (*Monthly Weather Review*, October, 1902, vol. xxx. No. 10) some interesting facts relative to the variation of precipitation at Salt Lake City, the water-level of the Great Salt Lake and some rainfall records from other localities in the States. The curves which he gives in the paper show a good agreement between the variation of the rainfall and the level of the lake, which led him to deduce that from 1827 to 1864 there was a dry cycle, from 1865 to 1886 a wet cycle, and from 1887 to the present time another dry cycle. To investigate the universality of these dry and wet periods he examined several American stations of about the same latitude. He found that the country west of the Rocky Mountains had its wettest cycle from 1866 to 1887, while the middle Mississippi and Ohio valleys had their heaviest precipitation from 1840 to 1859; thus, while the central portion of the country was receiving abundant rainfall, the west of the Rocky Mountains experienced "the longest dry cycle of which we have any record." At the present time, from San Francisco to Baltimore a dry cycle is in progress, and it is stated that "the past fifteen years have been the driest fifteen consecutive years on record for all the stations named, except Sacramento, and the drought is equally well marked there, but the fifteen years from 1851 to 1865 were a trifle drier." Mr. Murdoch examined the sun-spot curve to see if he could trace any connection between these periods of wetness and dryness, but he found none, years of minimum spots being sometimes excessively wet and sometimes excessively dry, and the same for the years of maximum sun-spots. How long will the present dry cycle continue? he asks, and he points out that a correct answer to this question would be worth millions of dollars to the people of the United States.

IN No. 13 (1902) of the *Annalen der Physik*, Herr Hans Lehmann publishes a list of the wave-lengths of the iron spectrum between λ 6811·30 and λ 8690·98, which should prove a useful standard of reference for wave-lengths in this region. Referring to Sir William Abney's conclusion that there is an upper limit to the spectra of certain metals, which the latter photographed during his experiments on the ultra-red region, Herr Lehmann states that his own experiments tend to confirm this conclusion.

PROF. J. TROWBRIDGE, who has been studying powerful electric discharges from condensers through hydrogen contained in silica-glass vacuum tubes, finds that by using this material for his tubes he can obtain and examine the most intense light yet studied in a laboratory (*Electrical Review*, November 22, 1902). His experiments show that to the eye the light of hydrogen appears to give a continuous spectrum, though photography reveals many bright and dark lines in the ultra-violet. Prof. Trowbridge considers that his results have an important bearing upon theories of the nature and constitution of stars and of the sun's spectrum, and that they open a new field in spectrum analysis.

AT Brescia in September, 1902, the Seismological Society of Italy held its first congress. An account of the proceedings, which extended over five days, and were largely devoted to seismometry, the Society publishes in its *Bulletin*, Nos. 4 and 5, vol. viii. One important discussion referred to the rate at which recording surfaces should be moved. Experience suggests that the speed to be adopted depends very largely upon the character of the earthquakes which are being studied. With earthquakes of local origin, waves with a period of 1/20 or 1/10 of a second may occur, whilst earthquakes of distant origin consist of waves which vary in period from 5 to 60 seconds. To obtain an open diagram of the former, the speed required for the recording surface should be so very much higher than for the latter that it would seem necessary to employ different types of apparatus for different types of earthquakes. Other discussions related to the form of unfelt seismic waves, modifications of the Rossi-Forel scale, the probable value of continuous determinations of the value of g in the vicinity of volcanoes, the establishment of a magnetic observatory in Sestola, to seismic periodicities and to other subjects. Many instruments and diagrams were exhibited, and under its able president, Prof. Pietro Tacchini, the Society is to be congratulated on the encouragement it has given to seismic research.

WE have received a paper by Father Algué, S.J., director of the Philippine Weather Bureau, on ground temperature observations at Manila. Underground temperatures have been regularly observed in Manila since the year 1895, with four thermometers placed 59·06 in., 29·53 in., 17·72 in. and 13·78 in. below the surface of the ground, and more recently three more have been added at depths of 9·84 in., 19·68 in.

and 39·38 in. Discussing the temperatures at 19·68 in. and 39·38 in. in detail, Father Algué finds that at the former depth the minimum of the year falls in December and the maximum in May; the minimum of the day occurs at 6 a.m., a secondary minimum at noon, and the maximum about 10 a.m. The daily range varies from about 6° C. in April to about 3° C. in the coldest months of the year; temperature is nearly constant from midnight to 6 a.m. At a depth of 39·38 in. the minimum temperature usually falls in December and the maximum in May; a large oscillation takes place from about 6 a.m. to 10 a.m., followed by a slight descent until 11 a.m.; from January to May temperature remains low to about 4 p.m., rises slightly until 5 p.m., and then remains steady all night until 6 a.m.

THE affective quality of auditory rhythm is the subject of a paper by Mr. Robert MacDougall in the *Psychological Review* for January, which deals more particularly with the external conditions of pleasurable or painful feeling in rhythm. Mr. MacDougall considers that the qualities of a rhythmical sequence which render it gay or restful are not attributable to secondary associations, but to the rhythm itself, and in particular to a relation of agreement between the rate of the rhythm and the prevailing mood of the observer. Variations in intensity of the rhythmical element are much less marked in their effect than variations of tempo. In regard to the proportion between the lengths of the various elements within the rhythm, it is found that those forms are the most pleasing in which the accentuated element is lengthened (as is commonly done in the recital of music or poetry), but a marked difference exists between trochaic and dactylic forms. In the former, equality of the two elements is the least pleasing form, while inverted types in which the unaccented element is lengthened have a peculiar character of their own which produces an agreeable sensation. In the dactylic form, the inversion of the intervals so as to give greater length to the unaccented element produces a more displeasing effect than absolute uniformity. The feeling of monotony when a rhythm is repeated is attributed to the tendency to differentiate between successive groups, and to combine them into larger rhythmical unities. The pleasure derived from pure rhythm is more marked in music than in poetry, where its continuity is continually interrupted by the stream of images aroused by the articulate sounds which support it.

MR. W. R. OGILVIE GRANT, of the Natural History Museum, has started on a collecting expedition to the Azores. Such an excellent all-round collector ought to obtain many novelties.

THE case of "recent additions" in the central hall of the British Natural History Museum contains an interesting series illustrative of burrowing animals. The exhibit at present includes a number of mammals, such as the common mole, star-nosed mole, golden moles, sand-moles, naked sand-rat, marsupial mole and duckbill, together with various burrowing snakes, beetles, molluscs, &c., as well as one species of bird.

IN *Naturwissenschaftliche Wochenschrift* of February 8 Dr. von Linden concludes his paper on the markings of animals, making special reference to the effects of change of temperature on those of the Lepidoptera, and pointing out that by means of such variations what are practically new species may be artificially produced.

IN the course of the second part of his article on the nests of bees, published in the *Biologisches Centralblatt* of February 1, Dr. von Buttel-Reepen publishes a phylogenetic table of the Apidæ, in which the honey-bees (Apinæ) and the stingless bees (Meliponinæ) are regarded as forming diverging branches from the ancestral humble-bees (Bombinæ).

IN response to a suggestion of Prof. Bardeleben, to the effect that a fresh study of the anatomy of generalised types of the different groups of vertebrates could scarcely fail to lead to good results, Dr. H. H. Wilder undertook the detailed examination of the skeleton of the American spotted salamander (*Necturus maculatus*). The result of his work, with numerous illustrations, forms vol. v., No. 9, of the *Memoirs* of the Boston Natural History Society.

IN a note in vol. xxvi. of the *Proceedings* of the U. S. National Museum, Mr. M. W. Lyon records the interesting fact that the females of the American bats formerly known as Atalapha, but now generally termed Lasiurus, are furnished with two pairs of mammæ, and generally produce from three to four young ones at a birth. A photograph of a female of the common North American *L. borealis*, with four young, is reproduced. Later on in the same volume Dr. L. Stejneger records the rediscovery of the *Salamandra quadrimaculata* of Holbrook, which inhabits Georgia and the Carolinas, and is entitled to rank as a distinct species of the genus Desmognathus.

THE *Irish Naturalist* for February records the breeding of that essentially Arctic bird, the red-necked phalarope, in the west of Ireland. In a series of notes on the birds of the Outer Hebrides, published in the *Annals of Scottish Natural History* for 1902 and January, 1903, Mr. J. A. Harvie-Brown adds the same species, together with the lesser tern, the pochard and the scaup-duck to the list of birds breeding in those islands. Mr. Brown mentions that although about 25,000 sea-birds of various kinds are annually killed by the islanders for food, yet this slaughter has no perceptible effect on the numbers of the feathered inhabitants of the islands. On the contrary, fulmar-petrels are steadily on the increase, and annually extending their breeding range.

THE *Emu* for January contains the presidential address of Colonel Legge read before the congress of the Australasian Ornithologists' Union. Reference is made to the good work done by the members of the Union, and especially to the success which has attended their official journal, the *Emu*. It is hoped that before long means may be found of illustrating that periodical, when necessary, with coloured plates. One of the most important papers to which the president referred is Mr. Le Souëf's note on the feathers of the emeu, in which it was pointed out that although the barring characteristic of the nestling plumage usually vanishes in the first year, yet that it occasionally reappears. Regret was expressed that the Tasmanian emeu, which probably belonged to a distinct race, was allowed to be exterminated before its characteristics were described. An excellent plate of a little penguin, with young, on its nest, forms a feature of the January number.

IN a paper on the Coleoptera of Colorado, published in vol. v., No. 3, of the *Bulletin* of the Iowa University, Mr. H. F. Wickham makes the following general remarks:—"The phenomena of distribution in Colorado are of much interest. Within a radius of a few miles we may find assemblages of species representing at least three distinct faunæ. The first, that of the great plains surrounding the mountains, is marked by a great development of wingless or imperfectly winged forms, probably largely invaders from the south, where we may suppose that the arid deserts first made their appearance, and where this characteristic feature is more in evidence among the beetles. . . . Occasionally these forms leave their natural haunts and extend for long

distances up the river valleys. . . . As we enter the timbered country on the higher foot-hills and lower mountain sides, we encounter a fauna which, while not unmixed with species that have come up from the plains, shows a strong affinity to the life about our Great Lakes. Higher still—from about 8000 to 9000 feet—we meet with species of genera still more boreal in their habits. . . . Above timber line the peaks sustain a few beetles which seem to be of Arctic origin, left probably by the retreating ice-sheets of the Glacial period."

In the January issue of the *Journal of Anatomy and Physiology*, Dr. Tims discusses the evolution of the cheek-teeth of mammals. In the development of the premolar series it is considered that the increase or suppression of the cusps of the cingulum has played a part. The molars appear to have attained complexity by the fusion of two or more simple teeth in the same line. The molars of a rabbit represent a simple type, in which two cones, with their cingulum, have been fused. In most rodents two cones seem to be involved, although in the water-vole four may be united. The two outer cusps on the upper molar of a dog represent two elements united by fusion, and the evolution of the molars of ruminants is believed to run on parallel lines. The author adopts the concrescence theory of dental evolution, so far as it relates to fusion in the molars of cones situated in the same line; but is unable to find evidence of fusion out of this line, and cannot accept the view that cones of two dentitions are represented in the molars.

The London Stereoscopic Company has sent us a list of cameras, lenses, optical lanterns and other apparatus connected with photography which are offered for sale at greatly reduced prices in order to make room for new articles. Opportunity is thus afforded for obtaining or supplementing a photographic outfit at much less than the usual cost.

The February number of the *Parents' Review*, the monthly organ of the Parents' National Educational Union, contains two articles treating of two distinct branches of nature-study. The first, on "The Boughs of the Branstock," by Mr. W. G. Collingwood, deals with the pictorial representation of trees in an artistic manner; the second, "A Plain Account of a Kerry Potato-patch," by Miss E. A. Magill, describes certain experiments designed to test what could be done by one individual with the least possible capital in the cultivation of a kitchen garden.

In pursuing his researches on the emanations from radioactive bodies, M. Henri Becquerel has recognised that the rays given off by polonium are identical with the *Kanalstrahlen* of Goldstein. In the current number of the *Comptes rendus*, M. Becquerel classifies the various rays as follows:—Uranium emits only one kind of radiation, charged with negative electricity and possessing high penetrating power. The emanation from polonium is charged with positive electricity, and is very easily absorbed, whilst the emanation from thorium and radium contains both kinds of rays.

The additions to the Zoological Society's Gardens during the past week include an Agile Wallaby (*Macropus agilis*), a Brush Turkey (*Talegalla lathami*), a Frilled Lizard (*Chlamydosaurus kingi*) from Australia, presented by Mr. H. W. Fawdon; a Two-spotted Paradoxure (*Nandinia binotata*) from West Africa, presented by Mr. C. W. Wilson; two Red-sided Tits (*Parus varius*), European, presented by Mr. Howard Williams; a Chimpanzee (*Anthropopithecus troglodytes*) from West Africa, three Coquerel's Mouse Lemurs (*Chirogaleus coquereli*) from Madagascar, three Bearded Lizards (*Amphibolurus barbatus*), a Blue-tongued Lizard (*Tiliqua scincoides*) from Australia, two Black-headed Buntings (*Emberiza melanocephala*), European, deposited.

OUR ASTRONOMICAL COLUMN.

Photographs of the North Polar Region.—In the February number of the *Bulletin de la Société astronomique de France*, M. Flammarion gives an interesting description, embodying a catalogue of positions and several charts, of a series of photographs of the region surrounding the North Celestial Pole. The article describes the obtaining of the photographs and also shows how they indicate very clearly the movement of the pole among the surrounding stars during short intervals of time. In the catalogue, 356 stars, all within 2° of the dole, are arranged in the order of their North Polar distances on September 3, 1902, and their magnitudes, coordinates and numbers in the Redhill (Carrington's 1857) catalogue of circumpolar stars are also given. The charts show the movement of the pole among these stars during the period 1600 to 2200 A.D., and that Polaris, which is at present No. 129 in the catalogue, will attain its minimum N.P.D. in the year 2104.

A Device for Obtaining Good Seeing.—In a paper communicated to the *American Journal of Science* for February, Prof. S. P. Langley describes a novel device which he has found efficient in producing steady images of the sun and stars when observed with the reflector of the Smithsonian Astrophysical Observatory, and he believes that it will have the same effect when used with refractors.

Generally the point aimed at in previous attempts to obtain "good seeing" has been to abolish all air currents in and about the telescope tube, but Prof. Langley has found by experiment that the definition is very little improved when this course is followed. After various experiments at different altitudes he arrived at the conclusion that it is the air within a few hundred yards, or even feet, of the telescope that has the greatest disturbing effect, and he endeavoured to find some method of tranquillising this. The reflector he was using was fed by a coelostat, and he caused the reflected beam to pass through a long three-walled tube which was covered by a canvas tent, so that the contained air was thoroughly well insulated from the variations of temperature and the draughts in the surrounding atmosphere. Very little relief was found as a result of this arrangement, so Prof. Langley tried an experiment of a somewhat paradoxical character, which he found to answer very well. He drew a strong current of air through the inner tube and introduced cross currents by several inlets at various points in the length, thereby thoroughly agitating and mixing the enclosed air. Taking some artificial double stars for his objects, he found that doubles which were blurred and inseparable under the former condition were plainly visible and sharply separated when the air was thus agitated. When the sun was observed under the new conditions it was found that the "boiling" on the limb, which is normally so annoying to the observer, was very nearly abolished. No quantitative results are yet ready for publication, but Prof. Langley has no doubts as to the general advantages to be obtained from the application of his method.

Proper Motion of the Sun Compared with Stellar Velocities.—In a paper communicated to Section A of the American Association for the Advancement of Science, Profs. Frost and Adams, of Yerkes Observatory, give the results they have obtained, using the Bruce spectroscope, of the radial velocities of twenty stars having spectra of the Orion type. The table of radial velocities included in the paper shows that of all the stars considered, those between 3 hours and 7 hours R.A. have a positive motion, *i.e.* they are receding, whilst those in the opposite region of the heavens, 16 hours to 20 hours R.A., have a negative motion, *i.e.* they are approaching. This difference is chiefly due to the velocity of the proper motion of the sun, and if the amount of this motion be subtracted from the values obtained, the remaining proper motions of the stars are very small, scarcely any of them having such great velocities as that of the sun.

Discovery of Ancient Astronomical Records.—During Prof. Hilprecht's excavations at Nippur, a library, which it is estimated contains 150,000 tablets, has been discovered. Many of the tablets refer to ancient astronomical records, and it is expected that when these are finally translated, some remarkable facts concerning the state of astronomical knowledge during the period about 2300 B.C. will be disclosed.

ANIMAL THERMOSTAT.[1]

A THERMOSTAT is an apparatus, or instrument, for automatically maintaining a constant temperature in a space, or a piece of solid or fluid matter with varying temperatures in the surrounding matter.

Where and of what character is the thermostat by which the temperature of the human body is kept at about 98°·4 Fahrenheit? It has long been known that the source of heat drawn upon by this thermostat is the combination of food with oxygen, when the surrounding temperature is below that of the body. The discovery worked out by Lavoisier, Laplace and Magnus still holds good, that the place of the combination is chiefly in tissues surrounding minute tubes through which blood circulates through all parts of the body, and not mainly in the place where the furnace is stoked by the introduction of food, in the shape of chyle, into the circulation, nor in the lungs where oxygen is absorbed into the blood. It is possible, however, that the controlling mechanism by which the temperature is kept to 98°·4 may be in the central parts, about, or in, the pumping station (the heart); but it may seem more probable that it is directly effective in the tissues or small blood-vessels in which the combination of oxygen with food takes place.

But how does the thermostat act when the surrounding temperature is anything above 98°·4 and the atmosphere saturated with moisture so that perspiration could not evaporate from the surface? If the breath goes out at the temperature of the body and contains carbonic acid, what becomes of the heat of combustion of the carbon thus taken from the food? It seems as if a large surplus of heat must somehow be carried out by the breath: because heat is being conducted in from without across the skin all over the body; and the food and drink we may suppose to be at the surrounding temperature when taken into the body.

Much is wanted in the way of experiment and observation to test the average temperature of healthy persons living in a thoroughly moist atmosphere at temperatures considerably above 98°·4; and to find how much, if at all, it is above 98°·4. Experiments might also, safely, I believe, be tried on healthy persons by keeping them for considerable times in baths at 106° Fahr. with surrounding atmosphere at the same temperature and thoroughly saturated with vapour of water. The temperature of the mouth (as ordinarily taken in medical practice) should be tested every two minutes or so. The temperature and quantity and moisture and carbonic acid of the breath should also be measured as accurately as possible.

P.S., December 5, 1902.—Since the communication of this note, my attention has been called to a most interesting paper by Dr. Adair Crawford in the *Philosophical Transactions* for 1871 ("Hutton's Abridgments," vol. xv. p. 147), "Experiments on the Power that Animals, when placed in certain circumstances, possess of producing Cold." Dr. Crawford's title expresses perfectly the question to which I desired to call the attention of the British Association; and, as contributions towards answering it, he describes some very important discoveries by experiment in the following passage, which I quote from his paper:—

"The following experiments were made with a view to determine with greater certainty the causes of the refrigeration in the above instances. To discover whether the cold produced by a living animal placed in air hotter than its body be not greater than what would be produced by an equal mass of inanimate matter, Dr. Crawford took a living and a dead frog, equally moist, and of nearly the same bulk, the former of which was at 67°, the latter at 68°, and laid them on flannel in air which had been raised to 106°. In the course of twenty-five minutes, the order of heating was as annexed.[3]

Min.	Air	Dead Frog	Living Frog
	°	°	°
In 1	—	$70\frac{1}{2}$	$67\frac{1}{2}$
,, 2	102	72	68
,, 3	100	$72\frac{1}{2}$	$69\frac{1}{2}$
,, 4	100	73	70
,, 25	95	$81\frac{1}{4}$	$78\frac{1}{4}$

"The thermometer being introduced into the stomach, the internal heat of the animals was found to be the same with that at the surface. Hence it appears that the living frog acquired heat more slowly than the dead one. Its vital powers must therefore have been active in the generation of cold.

"To determine whether the cold produced in this instance depended solely on the evaporation from the surface, increased by the energy of the vital principle, a living and dead frog were taken at 75° and were immersed in water at 98°, the living frog being placed in such a situation as not to interrupt respiration.[1]

Min.	Dead Frog	Living Frog
	°	°
In 1	85	81
,, 2	$88\frac{1}{2}$	85
,, 3	$90\frac{1}{2}$	87
,, 5	$91\frac{1}{2}$	89
,, 6	$91\frac{1}{2}$	89
,, 8	$91\frac{1}{2}$	89

"These experiments prove that living frogs have the faculty of resisting heat, or producing cold, when immersed in warm water; and the experiments of Dr. Fordyce prove that the human body has the same power in a moist as well as in a dry air; it is therefore highly probable that this power does not depend solely on evaporation.

"It may not be improper here to observe that healthy frogs in an atmosphere above 70° keep themselves at a lower temperature than the external air, but are warmer internally than at the surface of their bodies; for when the air was 77°, a frog was found to be 68°, the thermometer being placed in contact with the skin; but when the thermometer was introduced into the stomach, it rose to $70\frac{1}{2}$°. It may also be proper to mention that an animal of the same species placed in water at 61° was found to be nearly $61\frac{1}{4}$° at the surface, and internally it was $66\frac{1}{2}$°. These observations are meant to extend only to frogs living in air or water at the common temperature of the atmosphere in summer. They do not hold with respect to those animals when plunged suddenly into a warm medium, as in the preceding experiments.

"To determine whether animals also have the power of producing cold when surrounded with water above the standard of their natural heat, a dog at 102° was immersed in water at 114°, the thermometer being closely applied to the skin under the axilla, and so much of his head being uncovered as to allow him a free respiration.

In 5 minutes	the dog was	108°,	water	112°	
,, 6	,,	,,	109,	,,	112	
,, 11	,,	,,	108,	,,	112,	the respiration having become very rapid.
,, 13	,,	,,	108,	,,	112,	the respiration being still more rapid.
,, 30	,,	,,	109,	,,	112,	the animal then in a very languid state.

"Small quantities of blood being drawn from the femoral artery, and from a contiguous vein, the temperature did not seem to be much increased above the natural standard, and the sensible heat of the former appeared to be nearly the same with that of the latter.

"In this experiment a remarkable change was produced in the appearance of the venous blood; for it is well known that in the natural state the colour of the venous blood is a dark red, that of the arterial being light and florid; but after the animal, in the experiment in question, had been immersed in warm water for half an hour, the venous blood assumed very nearly the hue of the arterial, and resembled it so much in appearance that it was difficult to distinguish between them. It is proper to observe that the animal which was the subject of this experiment had been previously weakened by losing a considerable quantity of blood a few days before. When the experiment was repeated with dogs which had not suffered a similar evacuation, the change in the colour of the venous blood was more gradual; but in every instance in which the trial was made, and it was repeated six times, the alteration was so remarkable that the blood which was taken in the warm bath could readily be distinguished from that which had been taken from the same vein

[1] By Lord Kelvin. Read before Section A of the British Association, Belfast, 1902.

[2] Observations by Governor Ellis in 1758; teachings of Dr. Cullen prior to 1765; very daring and important experiments by Dr. Fordyce on himself in heated rooms, communicated to the Royal Society of London in 1774.

[3] In the two following experiments, the thermometers were placed in contact with the skin of the animals under the axillæ.—ORIG.

[1] In the above experiment, the water, by the cold frogs and by the agitation which it suffered during their immersion, was reduced nearly to $91\frac{1}{2}$°.—ORIG.

before immersion by those who were unacquainted with the motives or circumstances of the experiment.

"To discover whether a similar change would be produced in the colour of the venous blood in hot air, a dog at 102° was placed in air at 134°. In ten minutes the temperature of the dog was 104½°, that of the air being 130°. In fifteen minutes the dog was 106°, the air 130°. A small quantity of blood was then taken from the jugular vein, the colour of which was sensibly altered, being much lighter than in the natural state. The effect produced by external heat on the colour of the venous blood seems to confirm the following opinion, which was first suggested by my worthy and ingenious friend, Mr. Wilson, of Glasgow. Admitting that the sensible heat of animals depends on the separation of absolute heat from the blood by means of its union with the phlogistic principle in the minute vessels, may there not be a certain temperature at which that fluid is no longer capable of combining with phlogiston, and at which it must of course cease to give off heat? It was partly with a view to investigate the truth of this opinion that Dr. Crawford was led to make the experiments recited above."

These views of Dr. Crawford and "his worthy and ingenious friend, Mr. Wilson,[1] of Glasgow," express, about as well as it was possible to express before the chemical discoveries of carbonic acid and oxygen, the now well-known truth that oxygen carried along with, but not chemically combined with, food in the arteries, combines with the carried food in the capillaries or surrounding tissues in the outlying regions and yields carbonic acid to the returning venous blood, this carbonic acid giving the venous blood its darker colour, and being ultimately rejected from the blood and from the body through the lungs, and carried away in the breath. Crawford's very important discovery that the venous blood of a dog which had been kept for some time in a hot-water bath at 112° Fahr. was almost undistinguishable from its arterial blood proves that it contained much less than the normal amount of carbonic acid, and that it may even have contained no carbonic acid at all. Chemical analysis of the breath in the circumstances would be most interesting; and it is to be hoped that this chemical experiment will be tried, not only on dogs, but on men. It seems, indeed, with our present want of experimental knowledge of animal thermodynamics, and with such knowledge as we have of physical thermodynamics, that the breath of an animal kept for a considerable time in a hot-water bath above the natural temperature of its body may be found to contain no carbonic acid at all. But even this would not explain the *generation of cold* which Dr. Crawford so clearly and pertinaciously pointed out. Very careful experimenting ought to be performed to ascertain whether or not there is a surplus of oxygen in the breath; more oxygen breathed out than taken in. If this is found to be the case, the *animal cold* would be explained by deoxidation (unburning) of matter within the body. If this matter is wholly or partly water, free hydrogen might be found in the breath; or the hydrogen of water left by oxygen might be disposed of in the body, in less highly oxygenated compounds than those existing when animal heat is wanted for keeping up the temperature of the body, or when the body is dynamically doing work.

BACTERIAL TREATMENT OF CRUDE SEWAGE.

THE fourth report on the experimental treatment of crude sewage in settling tanks and coke-beds has just been made public by the London County Council.[2] The work under notice was commenced in April, 1898, at the Barking and Crossness outfall works, where the sewage of the County of London and of certain neighbouring districts is discharged into the lower Thames.

The plan of experiment was suggested by the chemical adviser to the Council, and has been carried out under his direction and supervision, with the cooperation of the chemists and superintendents at the outfalls. A very small fraction of the sewage only has been thus treated, but in quality it has fairly represented the immense volume which arrives continuously from the sewer system of the metropolitan area. The results which are summarised in the report may therefore be looked upon as representative, and the conclusions and recommendations which have been founded upon them may be considered to be reasonably applicable to the entire metropolitan sewage discharge. The report gives a general *résumé* of the four years' experimental work, which has now led to results of so satisfactory a nature that the tentative treatment has been discontinued with the view of making a commencement of work on the large scale.

The early experiments were carried out with crude sewage, which had only been screened from its grosser suspended matters. This was allowed to flow into tanks filled with fragments of hard coke of uniform size. As soon as this bed was filled to the surface of the coke, the sewage was allowed to remain at rest for two or three hours and was then drained off from below. After the coke had remained for about five hours with air in the interstices, a second quantity of sewage was allowed to flow in as before. This cycle of processes was repeated for many months, and in some later experiments for more than a year.

The sewage was clarified by this treatment, but no purification from dissolved organic matter occurred in the early stages with a new bed. After the bed had been at work for about a week, however, it gradually began to effect a marked purification of the sewage from its dissolved putrescible matter. After two or three weeks, the contact of the sewage with the coke effected a removal of from 50 to 60 per cent. of the dissolved putrescible matter. This degree of purification was steadily maintained when the bed had been once "matured," and the effluent sewage was found to be non-putrescible even when it was maintained at summer-heat (80° F.) in an incubator. Hence the oxidisable organic matter which remained in the effluent was not such as would lead to offence when the effluent was discharged into an ordinary watercourse.

The treatment of the crude sewage, as judged by chemical criteria, was therefore successful. Dr. Houston, however, stated that, bacteriologically considered, this effluent was not appreciably better than the clear untreated sewage. But this he considered to be unimportant in the case of an effluent which was discharged into the muddy and brackish lower river, the water from which could never be used for drinking purposes.

A more serious difficulty, however, was soon encountered. It became necessary to ascertain what was the working sewage capacity of the coke-bed, in order to be able to state what area of land would be required to be laid down in coke-beds for the treatment of the whole of the London sewage. On gauging at frequent intervals the sewage capacity of a bed, it was found that the capacity decreased at a uniform and rapid rate, and that after use for about two years the bed would become practically choked and unable to receive its supply of sewage.

An examination of the coke surfaces showed that a gelatinous growth had formed upon them; this proved to be bacterial in nature, and necessary for producing the purifying effect. It was found, however, that this growth was impregnated with a certain amount of grit, evidently road detritus, and that woody fibre from the wood pavements and chaff and straw fragments from the horse droppings in the streets were also present in some quantity. It appeared that the gelatinous bacterial growth was a normal and necessary result and was definite in amount, but that the other matters derived from the street traffic accumulated on the coke and reduced the sewage capacity of the bed at an almost uniform rate.

Experiments on the preliminary sedimentation of the sewage were made by allowing it to flow through troughs and tanks on its way to the bed, and they proved that the gritty and cellulose matters could be almost completely separated from the sewage before it reached the coke-bed, and that this could be effected without allowing the comminuted fæcal matter to settle in any large degree. The matter thus separated by subsidence could be dried and in large part consumed in a destructor, the mineral portion being left as a useful clinker. The sedimented sewage was found to undergo satisfactory purification in the coke-bed without diminishing its sewage capacity.

It was evident that coke-beds must not be allowed to receive mineral detritus from the wear and tear of the roads, and that the cellulose matters derived from the roads were equally objectionable since they were not removed by bacterial action in the coke-bed as

[1] Who, no doubt, was Dr. Alex. Wilson, first professor of astronomy in the University of Glasgow (1760-1784); best known now for his ingenious views regarding sun-spots.

[2] "Bacterial Treatment of Sewage." Fourth Report by Dr. Clowes. Published for the County Council by P. S. King and Son, 2, Great Smith Street, Westminster.)

rapidly as they were introduced by the sewage. But both the grit and the cellulose matters could be separated by sedimentation; and the cellulose matters might, according to modern research, be slowly resolved by the action of suitable bacteria, if such could be established. Accordingly, it was arranged that the crude sewage should undergo a preliminary settlement in a deep tank, where the sediment should remain undisturbed in the hope that bacterial resolution of the organic matters in the deposit might occur.

This settling or so-called "septic" tank was found after a time to effect the resolution of the cellulose matters most satisfactorily, the necessary bacteria being evidently contained in the sewage. The amount of sediment which should have been found at the bottom of the tank was estimated by carefully gauging the volume of sewage which passed through the tank in the course of six months and determining the amount of suspended matter which the sewage contained. When the actual amount of sediment present in the tank at the end of this period was measured, it was found to correspond to about 50 per cent. of the total quantity introduced, and the sediment which remained consisted largely of the grit which had not been previously separated. It was therefore possible to dispose of the troublesome cellulose matter by long-maintained bacterial action in the settling tank, and to prevent it from clogging the coke-beds.

The final experimental stage consisted in passing the screened crude sewage through a settling tank, which was of such capacity that the sewage required five hours to pass through it and was so arranged that the sediment was undisturbed by the flow. The effluent from this tank was received successively in a series of coke-beds, in which it was treated in the way already described. After two hours' contact with the coke, it issued as an inoffensive and non-putrescible effluent which readily maintained the life of fish. The sediment in the settling tank was left entirely undisturbed. As soon as it had become permeated with its suitable bacteria, more than 50 per cent. of it was resolved into gaseous and soluble substances, and it was certain that a preliminary sedimentation of the grit must have further increased this percentage.

The sewage capacity of the coke-bed, on the other hand, was carefully gauged at intervals. It was found that the capacity diminished during the formation of the bacterial growth upon the coke surfaces, and that when this was complete the capacity of the bed was about 30 per cent. of the whole space which had been filled with coke and with sewage. No permanent alteration in capacity occurred during many months, although the capacity temporarily rose or fell by a few units per cent. from the average.

It appeared, therefore, that the above method of treatment was applicable to London sewage and that it might now be applied on the large scale. The experimental work was accordingly suspended, and the conclusions arrived at were stated and recommendations were framed in the following words:—

"*Conclusions arrived at by the Experimental Treatment.*

"(1) That by suitable continuous undisturbed sedimentation the raw sewage is deprived of matter which would choke the coke-beds, and the sludge which settles ou is reduced in amount by bacterial action to a very considerable extent. This reduction might undoubtedly be increased by the preliminary removal of road detritus.

"(2) That the coke-beds, after they have developed their full purifying power by use, have an average sewage capacity of about 30 per cent. of the whole space which has been filled with coke.

"(3) That the sewage capacity of the coke-bed, when the bed is fed with settled sewage, fluctuates slightly, but undergoes no permanent reduction. The bed does not choke, and its purifying power undergoes steady improvement for some time.

"(4) That coke of suitable quality does not disintegrate during use.

"(5) That the 'bacterial effluent' of settled sewage from the coke-beds does not undergo offensive putrefaction at all even in summer heat, and can never become offensive. That this effluent satisfactorily supports the respiration of fish.

"(6) That the use of chemicals is quite unnecessary under any circumstances when the above method of treatment is adopted.

"*Recommendations founded on the above Conclusions.*

"It would appear desirable, therefore, without delay, to commence the treatment of the London sewage by the above bacterial method. The construction of the necessary works will take time and will involve expenditure, but unless it is taken in hand, all considerations tend to show that owing to the increased abstraction of water by the water companies, both at their existing intakes and at the newly constructed reservoirs for storm water at Staines, a large portion of the lower river will continuously deteriorate. This deterioration would arise from the increase in the amount of the discharge of sewage effluent and the decrease in the upper river flush. Possible trouble arising from these causes will be absolutely prevented by adopting, under proper conditions and on a large scale, the treatment which has been strikingly successful on the experimental scale. It must be remembered that the condition of the river cannot be improved by any suddenly adopted action.

"If the treatment is introduced without delay and is gradually extended it may reasonably be expected that the increasing deterioration in the lower river water will first be checked and will ultimately be prevented; while the gradual development of the treatment will cause the expenditure to be spread over a period of years, and will prevent it from being unduly burdensome.

"It must be remembered that the present settling channels would serve, as at present, for settling purposes, but by the altered method of working them they would also act as sludge destroyers. They should, however, undoubtedly be preceded by grit chambers.

"It must be further borne in mind that the expense involved in the purchase and application of chemicals would be dispensed with."

Other conclusions, which were incidentally arrived at during the above experimental work, may be mentioned. The material used for filling the bacteria bed seems to exert no considerable influence on the purification obtained; coke proved to be the most efficient, ragstone containing calcium carbonate was less efficient, but the difference in efficiency was not of serious amount.

The depth of the coke-bed did not materially affect its efficiency between the limits tried, which ranged from four feet to twelve feet. In the interspaces of the coke, even in the deepest bed, a satisfactory proportion of oxygen was present in the air; the bed was able to aërate itself without mechanical aid.

The amount of sewage dealt with satisfactorily by the system of intermittent filling of the coke-bed described above was greater than that which could be similarly purified by a continuous supply furnished by sprinkling or by other methods of distribution.

The report concludes with detailed information concerning the bacterial treatment of their sewage by the authorities in forty-eight of the principal centres of population in this country. This information has been supplied by the responsible officers from the centres concerned and has been brought up to date of April 30, 1902.

A consideration of this information in conjunction with that supplied concerning the London experimental work will probably be felt to justify the opinion "that the process (of bacterial treatment of sewage) has been uniformly successful when the construction and use of the necessary plant has been reasonably and properly carried out," and that the metropolis may now safely adopt this "natural" method of sewage disposal.

FRANK CLOWES.

SILICA GLASS.

A FEW weeks ago we described some of the excellent results obtained by Messrs. Heraeus, of Hanau, in their attempts to produce apparatus of "silica glass," and Prof. Dewar has added point to our remarks by exhibiting at the Royal Institution a "liquid air holder" made of silica, which had been made to order and sent by return of post, almost, from Hanau to London a few days before. Similar apparatus could have been made in England, it is true, but it could not have been produced by any means so quickly as at Hanau. Now we receive from America an account of an animated discussion on the subject of "silica glass" which lately took place at a meeting of the American Electrochemical Society at Niagara Falls on the occasion of the reading of a paper, by Mr. R. S. Hutton, of Manchester, on his method of casting silica tubes in the electric furnace, which shows that our American cousins

are as fully aware of the importance of this subject as our German competitors.

Truly, as Prof. Dewar said the other evening, there will soon be another "lost industry" if our practical men do not wake up. Silica glass making as an industry no doubt is still in earliest infancy, but though so young, it already shows signs of growth. But, alas! whilst two years ago England was first in this matter and the rest of the world, almost, nowhere, already England is only second, and is standing still, whilst Germany is first, and is going forward.

Everyone who has worked with silica, and knows its properties and how comparatively easy it is to work with, foresees that soon silica glass will replace ordinary glass in many of its most important applications, and yet though the foundations of the coming new industry were laid in this country, none of our manufacturers has been willing to take the small risks and trouble involved in an attempt to carry out in the workshop, and with electric furnaces, the new processes, or modifications of them, which have been worked out in the laboratories and placed at their disposal by the experimenters. It is true that owing to the initiative of one firm—Messrs. Baird and Tatlock—silica glass made by Mr. Shenstone's oxyhydrogen flame—or laboratory—process has for some time been available in this country. But can it be supposed that this essentially laboratory process is the last word of science, or of workshop practice, on this subject, or is likely to hold the field permanently, except for work on the small scale.

It is still fresh in our memories how the makers of optical glass waited until German manufacturers, aided by German men of science, had revolutionised and captured their industry. Unless something is done at once by the combined action of our men of science and manufacturers, history will repeat itself in the case of this new material.

SIR WILLIAM HOOKER'S SCIENTIFIC WORK.

SIR JOSEPH HOOKER contributes to the January number of the *Annals of Botany* a sketch of the life and labours of his father, Sir William Jackson Hooker, accompanied by a portrait. Sir William Hooker was born at Norwich on July 6, 1785, and in due course attended the Norwich Grammar School, but little is known of the progress he made there, though his son tells us that at home he devoted himself to entomology, drawing, and reading books of travel and natural history. Early in life he became interested in ornithology. That his entomological pursuits were, when still in his teens, appreciated by the veteran Kirby is evidenced by the latter having, in 1805, dedicated to him and his brother a species of Apion. The first evidence of his having taken up botany is the fact that he was the discoverer in Britain, in 1805, of *Buxbaumia aphylla*. His first published paper, entitled "Musci Nepalenses," was read before the Linnean Society in June, 1807. In 1809, following the suggestion of Sir Joseph Banks, Hooker visited Iceland, and in 1813 his "Journal of a Tour in Iceland" was published, though it had been privately circulated in 1811. In 1816 he produced the first part of a work entitled "Plantæ Cryptogamicae, quae in plaga orbis novi Aequinoctialis collegerunt Alex^r von Humboldt et Aimat Bonpland." The first volume of "Musci Exotici" appeared in 1818 and the second in 1820. Hooker was in 1820 appointed professor of botany at Glasgow University, and remained there until 1841, when he was appointed director of the Botanic Gardens at Kew. At Glasgow he met with the greatest success, and his herbarium and library before he had been there ten years were reckoned as amongst the richest private ones in Europe, and botanists of every nationality repeatedly visited them. The scientific works published during the Glasgow period were very numerous, and Sir J. D. Hooker gives a list of them in an appendix. The directorship at Kew Gardens was held by Sir William for twenty-four years, until his death on August 12, 1865. From 1855 he was assisted by his son, Sir Joseph Hooker, who was in that year appointed assistant director. Such are a few of the many incidents in an exceedingly busy life. Sir Joseph Hooker has conferred a favour upon men of science by bringing together, in convenient compass, the leading facts of an illustrious career.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. E. J. Routh, F.R.S., has been appointed a governor of Dulwich College, and Dr. E. W. Hobson, F.R.S., a governor of Derby School.

The special board for moral science propose that, in view of the progress of the department of experimental psychology under Dr. Rivers, an annual grant of 50*l.* shall be made towards the expenses of the department, and a special grant of 50*l.* for apparatus.

Mr. W. L. Mollison, Clare, has been appointed an elector to the Plumian professorship of astronomy; Dr. J. Larmor, F.R.S., has been appointed an elector to the same professorship, and to the Isaac Newton studentship; Prof. H. B. Dixon, F.R.S., of Manchester, an elector to the Jacksonian professorship of natural philosophy; Prof. H. A. Miers, F.R.S., of Oxford, an elector to the chair of mineralogy; and Dr. R. T. Glazebrook, F.R.S., an elector to the Cavendish professorship of experimental physics.

IT is announced in the *Globe* of February 21 that a commission has been appointed in Pretoria to inquire what steps can be taken for the creation of an institution to form part of a teaching university to provide the highest training in the arts and sciences connected with mining and other industries.

Two Pfeiffer scholarships in science, each of the annual value of 48*l.*, and tenable for three years at Bedford College for Women, will be offered for competition in June, 1903. Two Deccan scholarships, offered by Mrs. Thomson, of Poona, Bombay, of the value of 50*l.* each per annum for three years, will also be awarded.

THE principal of the Northampton Institute, London, Dr. R. Mullineux Walmsley, is being sent on a three months' tour to the United States and Canada for the purpose of investigating the present position of technical education in those countries and its bearings upon industrial production in the subjects covered by the technological work of the Institute, but more especially in the engineering industries.

A STATUTE enacting that persons who have passed the Abiturienten examination at a gymnasium in Germany, Austro-Hungary or Switzerland shall be exempt from Responsions and from the examination in an additional subject at Responsions at the University of Oxford was presented to a congregation of the University on February 17. The preamble of the statute was approved by congregation on February 3, and as no amendment had been proposed, the statute was submitted and approved.

SIR WILLIAM ABNEY, K.C.B., F.R.S., has accepted the post of adviser to the Board of Education in matters connected with science, upon his retirement from the post of principal assistant secretary to the South Kensington branch of the Board on April 1 next. It has been decided from that date to organise a division of the staff of the Board for matters connected with technology and higher education in science and art. The President has appointed Mr. Grant Ogilvie (at present the director of the Edinburgh Museum of Science and Art under the Scottish Education Department) to be a principal assistant secretary of the Board in charge of this division as from April 1 next. The Hon. W. N. Bruce, assistant secretary of the Board, is to be promoted on that date to be principal assistant secretary in charge of another division of the Board, which will be organised to deal with secondary schools.

THE council of the Association of Technical Institutions, after consultation with the London Members of Parliament, has adopted resolutions urging that it is of importance that an Education Bill for London should be passed into law during the present session; that there should be but one education authority for London for all grades of education, and such authority should be the London County Council, acting through an education committee constituted by statute; that a majority of this committee should be appointed by and out of the Council, and be so chosen that there shall be at least one County Council member from the City of London and from each metropolitan borough; and the committee should also include one person nominated by

the City Corporation, persons having experience in education and knowledge of local educational requirements, and persons to be appointed by the County Council on the nomination of certain suggested educational bodies to be specified in the Bill, among which are the University of London; the City and Guilds of London Institute; the trustees of the City Parochial Foundation; the Association of Technical Institutions; the Society of Arts; the London Chamber of Commerce; and five educational associations; that it is undesirable that there should be any delegation by the authority to such borough committees of powers with regard to education other than elementary.

At the third yearly meeting of the Court of Governors of the University of Birmingham, held on February 18, the principal, Sir Oliver Lodge, referring to the work of the past session, said the University was now recognised by the Board of Education as an inspecting agency for secondary schools in the midland district, and they wanted to inaugurate a new system of examination and inspection, as thereby they could do much good and could help the new education authority not only in the city, but in the neighbouring counties. No doubt some of those present were, or would be, connected with the education authorities in the surrounding districts, and he would say to them, "do not start new training colleges of your own detached from places of learning." At conferences which he had attended at Cambridge and Oxford, at which headmasters and educational workers from all parts of England were present, the opinion was unanimously expressed that teachers should be trained along with men preparing for other professions; that they should rub shoulders with professors and teachers not only in their own subjects, but in all subjects. He should like all teachers to train themselves to some extent both in science and in art. At the British Association, which would meet in September in Lancashire, Sir Norman Lockyer intended to devote a great part of his address to the duty of the State, and of England generally, in undertaking on a totally new and enlarged scale this vital subject to the future of this country. The University ought to take its share in the reorganisation of secondary education. Some secondary authorities were jealous of having university representatives upon them, but they did not want to be there to look after the interests of the university which they represented, but to act as experts, as advisers, not as controllers. If only they could get as professor of education a man of the right type, they might hope to train teachers and influence the youth of England by their means—to train them, he hoped, not in arts alone, nor in science alone, but in originality of thought and fertility of ideas generally.

The trustees of the Carnegie Trust for the Universities of Scotland met on Monday to receive the annual report and the scheme of endowment of post-graduate study and research drawn up by the executive committee. The *Times* summary of the report is here abridged. The report stated that there was a natural desire on the part of the universities that under the head of teaching the committee should assign a portion of the annual grants to be used as income. In certain cases of extreme urgency such grants had been given, but they had been limited, both in regard to amount and to the time for which they were payable. It was considered inadvisable to commit the committee to permanent obligations in this direction. Further, the committee considered that in the long run its plan would prove the best for the universities. The scheme adopted, besides making a contribution of 100,000*l*. to the buildings and permanent equipment, and of 20,000*l*. to libraries, would at the close of the period of five years have increased the resources for teaching in the four universities by permanent endowments amounting to 70,500*l*., while it would at the same time have made during those five years an addition of 1900*l*. a year to the income of two of them. With regard to the endowment of post-graduate study and research, the committee decided that scholarships, fellowships, and grants might with advantage be instituted, but that for many reasons it was not desirable to allot definite sums, or offer separate endowments, to individual universities and institutions. A common scheme had, therefore, been established, the administration of which would be retained in the committee's own hands. It was held that in no other way could the full advantage of this most important branch of the work of the Trust be adequately secured; and the committee regarded it as essential that those who were to profit by the opportunities offered for higher study and research should be the best the universities of Scotland could produce, and their work of the high character which alone was consistent with the intention of the founder. The nominations and applications under this scheme would be referred to an advisory board, consisting of the chairman, the four representatives of the universities and three other members of the Trust. There had been paid by the Trust for the summer session, 1902, the sum of 11,976*l*. 13*s*. on behalf of 1595 students, representing the fees of 4522 classes; and for the winter session, 1902-3, the sum of 28,275*l*. 5*s*. on behalf of 2867 students, representing the fees of 8806 classes—in all, for the year to December 31, 1902, 40,251*l*. 18*s*.

SCIENTIFIC SERIAL.

Journal of Botany, February.—A third contribution of occasional notes on freshwater algæ, which begins in this month's number, is presented by Mr. W. West and Mr. G. S. West. It represents mainly new British forms which have come under observation during the past two years. Several Chantransia and Lemanea forms, originally described by the late Prof. Sirodot, have been obtained in rapid streams in Yorkshire, Cornwall and Westmorland. To the Phæophyceæ are added *Phaeococcus paludosus*, and a new monotypic genus Phæosphæra. The more important additions to the Chlorophyceæ are *Uronema confervicolum*, *Pseudochaete gracilis* (a new genus), *Roya cambrica* and *Debarya desmidioides*. The last-mentioned is regarded by the authors as constituting a connecting link between the Desmidiaceæ and the Zygnemaceæ, since the filaments break up into individual cells, and conjugation occurs only between a pair of such isolated cells.—Continuing his remarks on *Calyptopogon mnioides*, Mr. E. S. Salmon separates this plant from Streptopogon on account of the papillose areolation and the form of the perichætial leaves, and from Barbula on account of the mitriform calyptra. A complete diagnosis, with an illustrative plate, is appended.—Two short lists of local plants are furnished, one referring to the Bournemouth district, by Mr. E. F. Linton, and the other giving new Bristol records, by Mr. J. W. White, in conjunction with Mr. C. Bucknall and Mr. D. Fry.—A series of "Wayfaring Notes from the Transvaal" is instituted by Dr. R. F. Rand, the first of which discusses botanical features to be observed in the neighbourhood of Johannesburg.—Mr. Garry continues his notes on the drawings for "English Botany."

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 12.—"On the Negative Variation in the Nerves of Warm-blooded Animals." By Dr. N. H. **Alcock**. Communicated by Dr. A. D. Waller, F.R.S.

The conclusions arrived at are:—

(1) It is possible to examine isolated mammalian and avian nerves under the same conditions as frog's nerves.

(2) There is no essential difference between the nerves of frogs, mammals and birds as regards their negative variation, excitability and reaction to anæsthetics.

(3) There is a marked difference in the extinction point for heat. The negative variation in frog's nerve is abolished at 40°–42° C., in rabbit's nerve at 48°–49°, in pigeon's nerve at 53°.

(4) This extinction point corresponds closely with the first coagulation point of the body proteids, where these are known, and thus coagulation is probably the cause of the permanent loss of irritability of the nerve.

(5) The point at which the nerves are paralysed by cold is $-3^{\circ}{\cdot}5$ in the frog, $-1^{\circ}{\cdot}4$ in the hedgehog, $+3^{\circ}{\cdot}8$ in the rabbit and $+6^{\circ}{\cdot}9$ in the pigeon.

"Studies in the Morphology of Spore-producing Members. No. V. General Comparison and Conclusion." By Prof. F. O. **Bower**, F.R.S., Regius Professor of Botany in the University of Glasgow.

Geological Society, February 4.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The granite and greisen of Cligga Head (West Cornwall), by Mr. J. B. **Scrivenor.** The small granite-mass between St. Agnes and Perranporth is a remnant of a larger mass which has been partly denuded and partly hidden by a fault; "bedding" is well developed. The granite bordering the bedding-planes has been altered into greisen. Each greisen-band contains a quartz-vein, marking the original fissure along which metasomatism took place; the veins contain tourmaline, cassiterite, wolfram, mispickel and chalcopyrite. Two main reactions appear to have taken place in the formation of the greisen: the felspars affording topaz, muscovite and secondary quartz; the biotite brown tourmaline, magnetite and secondary quartz. The greisen is an example of Prof. Vogt's "pneumatolytic" action in thoroughly acid rocks.—Notes on the geology of Patagonia, by Mr. J. B. **Scrivenor.** The sedimentary strata consist of Tertiary, Cretaceous and Jurassic formations, which, with the exception of the Jurassic, yield varied faunas, both vertebrate and invertebrate. Except in the north, where intrusions of an acid type have disturbed the sediments, the southerly dip is so gentle as only to be appreciable where sections can be followed for some distance. Mr. Hatcher considers that an unconformity separates the Magellanian and Guaranitic Series, also the Cretaceous and Jurassic. Very little is known of the igneous rocks. Apart from those of the Cordillera, there are vast plateaux of basalt and intrusions of quartz-porphyry. The specimens of igneous rocks collected from the moraines of the Cordillera comprise biotite-granite, hornblende-granite, quartz-mica-diorite, gabbro, hornblende-picrite, quartz-porphyry, rhyolite, obsidian, ophitic olivine-dolerites, olivine-basalts and acid tuffs. The basalt-flows cover an enormous area. They slope gently towards the Atlantic, and are cut off from the Cordillera by a longitudinal depression. All that can be said of their age is that they are older than the transverse depressions of the Cordillera, and older than the glaciation of the eastern slopes of that chain. The Téhuelche Pebble-Bed, which covers nearly the whole of Patagonia, has been ascribed to marine action by some authors, by others to glacial action. A third suggestion is the agency of big rivers. The drainage-system includes several eastward-flowing rivers and numerous lakes, some of which occupy transverse valleys cutting through the Cordillera.—On a fossiliferous band at the top of the Lower Greensand, near Leighton Buzzard (Bedfordshire), by Mr. G. W. **Lamplugh** and Mr. J. F. **Walker.** This paper describes a newly-discovered fossiliferous band at the top of the Lower Greensand, overlain by the Gault, in the sand-pits at Shenley Hill, near Leighton Buzzard, in Bedfordshire. The fossils of this band present a different facies from that of any other previously-known fossiliferous horizon of the Lower Greensand, and show closer affinities with the fauna of the Upper Greensand than have hitherto been recognised in any deposit below the Gault. The fossiliferous bed is marked off from the underlying unfossiliferous "silver-sands," but more from the overlying Gault. Stratigraphically it forms part of the Lower Greensand, and cannot be considered to belong to the Gault. The fossils constitute the newest Lower Cretaceous fauna as yet recognised in England.

Royal Meteorological Society, February 18.—Captain D. Wilson-Barker, president, in the chair.—Mr. E. **Mawley** presented his report on the phenological observations for 1902. In all parts of the British Isles, the phenological year ending November 30, 1902, was for the most part cold and sunless. Rain fell at unusually frequent intervals, so that, although the total quantity proved deficient, there at no time occurred any period of drought. Wild plants were everywhere behind their mean dates in coming into flower, but the departures from the average were, as a rule, slight, until about the middle of May. After that time, until the end of the flowering season, the dates of blossoming were later than in any other year since the present series of records was instituted in 1891. The swallow, cuckoo and nightingale were a few days earlier than usual in making their appearance. The most remarkable feature as regards the weather and its effect on vegetation was the way in which it favoured the growth of all the farm crops, except potatoes and hops. For it is seldom in the same year that the yields of wheat, barley, oats, beans, peas, turnips, mangolds and grass are alike abundant, even in a single district, much less in all parts of the kingdom, as was the case in 1902. On the other hand all the fruit crops were more or less deficient, with the exception of strawberries, which yielded well, but were like most other fruits, lacking in flavour.

Cambridge.

Philosophical Society, January 19.—Mr. Seward, vice-president, in the chair.—On the invariant factors of a determinant, by the president (Dr. **Baker**).—On the variation with wave-length of the double refraction in strained glass (second paper), by Mr. L. N. G. **Filon.**—On the alimentary canal of the mosquito, by Mr. A. E. **Shipley.** The paper dealt with the alimentary canal of *Anopheles maculipennis*, Meig., special attention being paid to the mechanism by which "biting" is effected and by which the food is pumped up into the pharynx. Three food reservoirs were described. The alimentary canal, the salivary glands and the Malpighian tubules were described in detail.—A second memoir on integral functions, by Mr. E. W. **Barnes.** In this paper the author continues certain researches on the asymptotic expansions of integral functions which were published in the *Philosophical Transactions* of the Royal Society, Series A, vol. cxcix. pp. 411–500 (1902). Asymptotic expansions are obtained for the standard functions of double sequence, and an attempt is made to classify Taylor's series by means of the asymptotic expansion of the inverse of the mth root of the mth coefficient.—On the theory of shadows, by Mr. H. M. **Macdonald.**

Dublin.

Royal Dublin Society, January 20.—Prof. W. F. Barrett, F.R.S., in the chair.—Prof. J. **Joly**, F.R.S., gave a further account of his preliminary experiments on the conservation of mass which he had presented at the meeting of December 16, 1902.—A paper was read by Dr. W. E. **Adeney** on the ultra-violet spark spectrum of ruthenium. The first instalment of wave-length determinations in spark spectra from the large Rowland spectrometer in the Royal University, Dublin, is given in this communication, reproductions of photographs from which have already been published in the *Scientific Transactions* of the Royal Dublin Society, vol. vii., 1901. 1461 lines have been measured between the two extreme limits of wave-lengths 2263 and 4560. Kayser has given 1613 lines as occurring in the arc spectrum between the same limits of wave-length. About 800 lines are common to both forms of the spectrum. Very few in either list are due to impurities. Exner and Haschek have measured 2250 lines between the same limits of wave-length; some 1330 of these occur in the author's photographs.

Manchester.

Literary and Philosophical Society, January 20.—Mr. Charles Bailey, president, in the chair.—Mr. Thomas **Thorp** gave an account of some researches he had made on the production of metallic surfaces having the properties of Japanese "magic" mirrors. A passage was read from "Light, Visible and Invisible," by Prof. Silvanus Thompson, pp. 51–52, relative to the manufacture of these mirrors in Japan, from which it appears that scraping is resorted to previous to polishing, great pressure being used. These researches were undertaken by Mr. Thorp with a view to determine whether the same "magic" effect can be produced by the ordinary methods of grinding and polishing. Replicas of a Japanese mirror capable of showing the "magic" effect in a very slight degree were made in hard bronze (bell metal). One of these was ground and polished by the method used for glass, &c., considerable pressure being used in the polishing. The result was a decided improvement on the original. The second replica was now ground and polished in a similar manner, but under conditions which prevented flexure during the processes. The result was a plane mirror, without the "magic" properties. As straining the first mirror had been noticed to give enhanced effects, the plane mirror was now subjected to uniform pressure from the back, when the design was seen to start out in a very decided manner, being much brighter than the rest of the surface. On the mirror

being subjected to a partial vacuum, again from the back, portions of the design were seen to be darker than the surrounding surface, but bordered with a light fringe. It appears now to be thoroughly established that the cause of the "magic" effect in Japanese mirrors is due to the unequal resistance to flexure during the polishing process.

Paris.

Academy of Sciences, February 16.—M. Albert Gaudry in the chair.—The **President** announced to the Academy the death of Sir George Gabriel Stokes, foreign associate.—A law relating to the electromotive forces of batteries based on the reciprocal action of saline solutions and soluble electrolytes, by M. **Berthelot.**—A direct and simple calculation of the velocity of propagation of a wave front in a medium having complicated equations of motion, by M. J. **Boussinesq.**—On the radiation of polonium and radium, by M. Henri **Becquerel.** In a previous paper the author has shown that the α-rays of Rutherford, which are probably identical with the *Kanalstrahlen* of Goldstein, are capable of a slight deviation in a strong magnetic field. The present paper is devoted to a proof of the existence of a corresponding property in the radiation from polonium. Owing to the very slight photographic action of the specimen of polonium under examination, the action had to be prolonged for twenty hours. The same apparatus was used for comparative experiments with radium. The two photographic proofs, the one with radium and the other with polonium, appeared to be superposable, thus proving the absolute identity under the conditions of the experiment of the α-radium rays and the polonium rays. In neither case was there any trace of dispersion analogous to that observed with the kathode rays.—On some new syntheses effected by means of molecules containing the methylene group associated with one or two negative radicles. The action of epichlorhydrin on the sodium derivatives of acetone-dicarboxylic esters, by MM. A. **Haller** and F. **March.** The sodium derivative of acetone-dicarboxylic acid condenses readily with epichlorhydrin, giving a keto-lactone, the properties of which, with those of its semicarbazone, are described.—Approximate algebraic expressions for transcendental, logarithmic and exponential functions, by M. J. A. **Normand.** A series of formulæ is developed permitting of the rapid calculation of the numerical value of logarithms. Numerous examples showing the degree of approximation are appended.—Remarks by M. **Considère** on a memoir on the resistance of armed mortars.—M. René Benoit was elected a correspondant in the section of physics in succession to the late Prof. Rowland.—The eruption of Mont Pelée in January, 1903, by M. A. **Lacroix.**—Perturbations independent of the eccentricity, by M. Jean **Mascart.**—Researches on electrolytic valves, by M. Albert **Nodon.** The term electrolytic valve is applied to an electrolytic cell for the conversion of an alternating current into a unidirectional current. Metals having a low atomic weight, such as magnesium or aluminium, are the best for this purpose, and a solution of ammonium phosphate forms the best electrolyte. The electrostatic capacity of these cells is considerable, about 1 farad per square centimetre of surface of aluminium, the thickness of the dielectric which forms the condenser being of the order 10^{-8}, or of molecular order. Such a cell may be successfully applied to the rectification of telephone currents, and can be used for their measurement.—On the induced radio-activity produced by salts of actinium, by M. A. **Debierne.** It is known that the compounds of radium possess the property of rendering bodies placed in their vicinity temporarily radio-active. Actinium salts possess the same property, the effects produced presenting the same general characters as with radium. There are, however, differences distinguishing the action of the two elements.—The conditions of estimation of manganese in acid solution by persulphates, by M. H. **Baubigny.** A series of determinations is given, showing the effect of the nature of the acid, its quantity and the amount of persulphate used.—The heats of formation of some sulphur and nitrogen compounds, by M. Marcel **Delépine.**—The action of hydrogen upon silver sulphide in the presence of the sulphides of antimony and arsenic, by M. H. **Pélabon.**—The action of phosphoric acid upon erythritol, by M. P. **Carré.** Phosphoric acid acts upon erythritol firstly as a dehydrating agent, and then forms a mono-ester of erythrane. A portion of the latter is converted into a di-ester.—The preparation of some combinations of α-methyl-α-isopropyl-adipic acid, by M. C. **Martine.**—On the temperature of calefaction, and on its use in alcohol determinations, by M. **Bordier.** The term point of calefaction is applied to the temperature at which contact ensues between a hot plate and a drop of liquid in the spheroidal state. In the case of mixtures of alcohol and water this temperature is a function of the composition, and the use of this method is suggested as a means of determining the amount of alcohol in solution. It has the advantage of requiring only a very small quantity of liquid.—On the pathogenic action of the rays emitted by radium on different tissues and organisms, by M. J. **Danysz.** The action is most intense on the skin, the action being relatively slight upon the underlying tissue and attached muscle. The nervous system is especially sensitive to the action of the rays. The larvæ of insects exposed to the rays were paralysed in twenty-four hours and died two days later.—The mechanism of the action of secretin on the pancreatic secretion, by M. C. **Fleig.** The experiments given tend to show that secretin acts directly upon the pancreas, either acting directly upon the pancreatic cell or on the excito-secretory elements. Secretin, contrary to the views of Popielski, offers a good example of special chemical substances which, by their diffusion in the blood current, establish relations between certain determined organs.—The action of the fundamental vibrations of the vowels on the ear in a pathological state, by M. **Marage.**—On the implantation of dead bone in contact with living bone, by MM. V. **Cornil** and P. **Coudray.** Dead bone remains very nearly in the condition in which it was implanted, embedded in a fibrous capsule. It behaves almost like a foreign body, its resorption, even at the end of six months, being insignificant.—On Châtaignier's disease, caused by *Mycelophagus Castaneae*, by M. L. **Mangin.**—A new genus of Chytridiaceæ, by M. P. A. **Dangeard.**—Phenomena of transportation in the eastern Mediterranean, by M. L. **Cayeux.**—The absorption of ammonia by sea-water, by M. J. **Thoulet.**

New South Wales.

Royal Society, December 3, 1902.—Prof. Warren, president, in the chair.—On the occurrence of an important geological fault at Kurrajong Heights, Blue Mountains, by Prof. T. W. Edgeworth **David,** F.R.S. Traced in a southerly direction across the Grose Valley to Glenbrook Railway Station, the fault dies out, passing into a gentle westerly fold, which does not appear to have been accompanied by shearing. To the east is the well-known steep *easterly* monocline. Traced northerly, the monocline crosses Grose Valley and forms the eastern slope of Kurrajong Heights. The monocline at the Kurrajong is bounded westwards by an abrupt fault, whereas at Glenbrook the line of disturbance takes the form of a gentle fold facing the west. The fault plane, though somewhat eroded, still forms a steep and very conspicuous escarpment. The effect of this fault in displacing the Coal-measures on either side of it will obviously claim the serious attention of those who, in the future, have charge of coal mines in that portion of our coalfields.—Investigations in regard to the comparative strength and elasticity of Portland cement, mortar and concrete, when reinforced with steel rods and when not reinforced, by Prof. W. H. **Warren.** The paper describes experiments on various mortars and concrete in tension and compression, also when subjected to bending stresses. The extensions of the specimens subjected to direct tension when reinforced with steel rods were considerably less than occurred in similar specimens not reinforced; the stress-strain diagrams plotted from the observations taken were all convex to the stress axis, but the curve was much flatter for the reinforced specimens. The transverse tests consisted of experiments with beams reinforced on the tension side with steel rods, compared with similar beams not reinforced. In all cases the reinforced beams were from $5\frac{1}{2}$ to 10 times stronger than the plain beam, and the deflections of the beams before fracture were enormously greater in the reinforced beams.—The fallacy of assuming that a wet year in England will be followed by a wet year in Australia, by H. C. **Russell,**

F.R.S. It is a widespread idea that if abundant rain falls in England there will be an abundant rainfall in Australia in the following year. By means of a diagram showing the rainfall in England and in Sydney for a number of years in succession, it is shown that, as a matter of fact, this seldom occurs.—On the presence of platinum and iridium metals in meteorites, by Prof. **Liversidge,** F.R.S. The author described the occurrence of gold in meteorites; in certain cases, the gold is accompanied by one or more of the platinum and iridium metals. The Boogaldi meteorite contains both gold and one or more of the platinum metals; these metals do not appear to be uniformly diffused through the meteorite, for some parts apparently contain a much larger proportion than others. The amount of the platinum metals in the Boogaldi meteorite is comparatively large, being at the rate of several ounces per ton.—Is Eucalyptus variable? by Mr. J. H. **Maiden.** The author takes the following characters seriatim, and shows that they all vary:—Habit, bark, timber, exudations, petiole, leaf—(*a*) suckers, (*b*) cotyledon leaves, (*c*) venation, (*d*) young stems, (*e*) essential oil, (*f*) stomata—galls, inflorescence, anthers, pollen-grains, calyx, fruit.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 26.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Solid Solution and Chemical Transformation in the Bronzes: C. T. Heycock, F.R.S., and F. H. Neville, F.R.S.

ROYAL INSTITUTION, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

SOCIETY OF ARTS, at 4.30.—Gleanings from the Indian Census: J. A. Baines.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Nernst Lamp: J. Stöttner.—And, *if time permit*, Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuit by the Aid of Oscillograms: M. B. Field.

FRIDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 9.—Perfumes: Natural and Artificial: Dr. A. Liebmann.

PHYSICAL SOCIETY, at 5.—On the Measurement of Small Capacities and Inductances: Prof. Fleming and Mr. Clinton.—On the Interpretation of Milne Seismograms: Dr. Farr.—On the thickness of the Liquid Film formed by Condensation at the Surface of a Solid: Dr. Parks.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Relative Advantages of Single Screws, Twin Screws, and Triple Screws, for Marine Propulsion: E. Falk.

SATURDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30.—The British Vespidæ and their Vespiaries: Edward Connold.

MONDAY, MARCH 2.

SOCIETY OF ARTS, at 8.—Hertzian Wave Telegraphy in Theory and Practice: Prof. J. A. Fleming, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Need of Duty-Free Alcohol for Industrial Purposes: Thomas Tyrer.

TUESDAY, MARCH 3.

ROYAL INSTITUTION, at 5.—Recent Advances in Photographic Science: Sir William Abney, K.C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed.*—Mechanical Handling of Material: G. F. Zimmer.—*Succeeding Papers.*—Recent Irrigation in the Punjab: S. Preston.—The Irrigation Weir across the Bhadar River, Kathiawar: J. J. B. Benson.

ZOOLOGICAL SOCIETY, at 8.30.—Observations and Experiments on Japanese Long-Tailed Fowls: J. T. Cunningham.—On the Land Operculate Mollusca collected during the "Skeat Expedition" to the Malay Peninsula: E. R. Sykes.—The Significance of the Callosities on the Limbs of the Equidæ: R. Lydekker.

SOCIETY OF ARTS, at 4.30.—The Uganda of To-day: Herbert Samuel.

WEDNESDAY, MARCH 4.

SOCIETY OF ARTS, at 8.—Education in Holland: J. C. Medd.

ENTOMOLOGICAL SOCIETY, at 8.—The Aculeate Hymenoptera of Barrackpore, Bengal: G. A. James Rothney.—Notes on the Nests of Bees of the Genus Trigona: Charles Owen Waterhouse.—On the Aganiidæ in the British Museum, with Descriptions of some New Species: Colonel C. Swinhoe.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—The Resistance of the Ions and the Mechanical Friction of the Solvent: Prof F. Kohlrausch, For. Mem. R.S.—The Electrical Conductivity of Solutions at the Freezing Point of Water: W. C. D. Whetham, F.R.S.—A Note on a Form of Magnetic Detector for Hertzian Waves adapted for Quantitative Work: Prof. J. A. Fleming, F.R.S.—On the Laws governing Electric Discharges in Gases at Low Pressures: W. R. Carr.—The Differential Invariants of a Surface, and their Geometric Significance: Prof. A. R. Forsyth, F.R.S.

ROYAL INSTITUTION, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.

CHEMICAL SOCIETY, at 8.—The Mechanism of the Reduction of Potassium Bichromate by Sulphurous Acid: H. Bassett.—The Constitution of Pilocarpine. Part IV.: H. A. D. Jowett.—Preparation and Properties of 1:4 (or 1:5)-Dimethyl Glyoxaline and 1:3-Dimethyl Pyrazole: H. A. D. Jowett and C. E. Potter.—Some Analyses of "Reh," or the Alkaline Salts in Indian Usar Land: E. G. Hill.—Experiments on the Synthesis of Camphoric Acid. Part III. Synthesis of Isolauronolic Acid: W. H. Perkin, Jun., and J. F. Thorpe.—Camphor-β-thiol: T. M. Lowry and G. C. Donington.—Isomeric Change of Dibenzanilide into Benzoylortho-amino- and Benzoylpara-amino- Benzophenone: F. D. Chattaway.—The Rate of Decomposition of Diazo-Compounds. Part III. The Temperature Coefficient: J. C. Cain and F. Nicoll.

LINNEAN SOCIETY, at 8.—On some Points in the Visceral Anatomy of the Characinidæ: W. S. Rowntree.—On the Anatomy of the Pig-footed Bandicoot *Chaeropus castanotis*: F. G. Parsons.—Further Notes on Lemurs: Dr Elliot Smith.

RÖNTGEN SOCIETY, at 8.30.—Spark Phenomena: F. H. Glew.

FRIDAY, MARCH 6.

ROYAL INSTITUTION, at 9.—Studies in Experimental Phonetics: Prof. J. G. McKendrick, F.R.S.

SATURDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 5, 1903.

ELECTRICAL STIMULUS AND RESPONSE.

Response in the Living and Non-Living. By Jagadis Chunder Bose, M.A. (Cantab.), D.Sc. (Lond.). Pp. xix + 199; with illustrations. (London: Longmans, Green and Co., 1902.) Price 10*s.* 6*d.*

THE apparent aim of this book is to show that "living response in all its diverse manifestations is found to be only a repetition of responses seen in the inorganic" (p. 189). It is difficult to treat this conclusion seriously, and the difficulty is sensibly increased by the mental bewilderment which is experienced on reading such statements as the following:—

"From a confusion of 'dead' things with inanimate matter it has been tacitly assumed that inorganic substances, like dead animal tissues, must necessarily be irresponsive, or incapable of being excited by stimulus—an assumption which has been shown to be gratuitous" (p. 181).

The conclusion which we are compelled to draw from this quotation is that Prof. Bose does not regard dead things as inanimate matter, and if this be the case, it may seem superfluous to offer any extended criticism of those portions of the book which set forth the experimental grounds for such beliefs. It is, however, very desirable that discredit should not be thrown upon the use of fruitful methods of investigation well known to physiologists in consequence of the fallacious character of the author's conclusions; moreover, the experiments upon which he rests his case are set forth in a somewhat convincing manner, and the book may with the aid of copious illustrations achieve some popularity.

The experimental facts brought forward comprise, (1) some limited aspects of the changes occurring in muscles, nerves and plants when subjected to particular modes of stimulation, and (2) some electrolytic effects occurring when moist conductors are brought into contact with metallic surfaces and the latter are caused to vibrate. It is on the strength of a superficial resemblance between the electromotive changes observed in these two groups that the author makes his astounding generalisations. The phenomena of muscle and nerve brought forward are taken from various physiological works, and the particular response selected is that of the familiar excitatory electromotive change; it is, however, very inadequately treated, as no reference is made to the classical researches of Du Bois-Reymond, Hermann, Bernstein, Hering, Burdon Sanderson and others.

In consequence of the author's limited survey of the subject, he has fallen into an error of quite an elementary nature in his description of the muscular response. He appears to think that the superficial resemblance between the change of form which muscle undergoes in contraction and the swing of a galvanometer needle when deflected by the sum of the electrical currents present in tetanised muscle affords sufficient ground for the statement that "it is found that the electrical and mechanical records are practically identical" (p. 12). This identity can only refer to the time relations of the two classes of events, and it has been known for half a century that the electrical and mechanical responses do not run the same course. The results obtained by the physiological rheoscope, the repeating rheotome, the telephone and the capillary electrometer (all disregarded by the author) afford convincing proof that whereas the change of form during so-called tetanus is sustained by the fusion of the successive mechanical responses, the electrical disturbances are not so fused, but constitute a rhythmical series of distinct states. The time relations of the muscular twitch evoked by a single stimulus reveal the reason for this want of parallelism, since the electrical response has both culminated and subsided before the mechanical one has been completed. The author having thus disregarded the most fundamental characters of muscular and nervous responses, *i.e.* their time relations, it is clear that no sweeping generalisations involving these responses are justifiable.

In treating the vegetable tissues, the author has selected as a typical response an electrical change which occurs in portions of plants which have been subjected to sudden mechanical strain (torsion, &c.). The displacement caused by the strain is associated with a difference of electrical potential in the part primarily affected as compared with other parts situated in more remote, and thus less disturbed, regions. These electrical alterations are of considerable interest, and attention has been drawn to their existence by Waller, who has pointed out their local character. The local character of the electromotive effect has its counterpart in animal tissues, but it is not characteristic of those particular animal responses which are selected by the author for the purpose of comparison, since these are propagated from the seat of stimulation along the protoplasmic continuum of the muscle or the nerve fibres. Propagated effects of this type can be found in certain plant tissues—for instance, Dionæa—but the plant responses described by Prof. Bose do not include these. It follows, therefore, that such comparisons as the author is able to make do not warrant the sweeping statement that

"a complete parallelism may be held to have been established between plant response on the one hand and that of animal tissue on the other" (p. 80).

Some curious chapters in the book deal with a novel "response in metals." This was generally obtained by connecting a strip of metal (tin, platinum, &c.) with moist conductors, which in their turn were connected with a galvanometer through non-polarisable junctions; the sudden jar of a blow was the so-called stimulus, and the alterations caused by the shatter in the polarisation interfaces appear to constitute the so-called electrical response. The observations are brought forward by Prof. Bose, not so much for any intrinsic physical interest they may possess, as for the purpose of showing how far they are susceptible of modification under conditions which, in his opinion, also modify the electromotive phenomena of living tissues and thus of serving as a support for his speculations. The language employed in their description is often of a singular character; thus

T

we are told that "tin is practically indefatigable" (p. 118), that

'we may thus, by reducing or abolishing the excitability of one end by means of suitable chemical reagents (so-called method of injury) obtain response in metals" (p. 87),

and many other phrases borrowed from physiologists occur plentifully in the text. The use of such terminology appears in itself to indicate the unconscious bias of the author towards the conclusion he has in view.

In later chapters of the work, a series of apparent resemblances between the retinal currents described by physiologists and photoelectrolytic changes in sensitised metal plates leads the author to the amazing assertion that

"there is not a single phenomenon in the responses, normal and abnormal, of the retina which has not its counterpart in the sensitive cell constructed of inorganic material" (p. 169).

After this, we are incapable of being further surprised, even by the confident prediction that

"the parallelism will thus be found complete in every detail between the phenomena of response in the organic and inorganic" (p. 147).

We are all aware that living processes, apart from the evidence of our own consciousness, can only reveal themselves as physical and chemical changes; among these are the electromotive effects in living tissues which afford one aspect of those subtle and complex physico-chemical relationships comprised under the term metabolism. The play and nature of this metabolism constitute for most of us the fundamental mystery of life; but to Prof. Bose the living response presents "no element of mystery" (p. 189). Metabolism, with its phases of assimilation and dissimilation, has for him no significance, and he characterises all correlations of electromotive change with metabolic process as arbitrary and unnecessary assumptions (p. 126). Even the connection of fatigue in animal tissues with the dissimilation products of activity has, he says, long been seen to be an inadequate explanation. He admits that "the criterion by which vital response is differentiated is its abolition by the action of certain reagents" (p. 188), yet he declares that metals can be "transformed from a responsive to an irresponsive condition by the action of similar poisonous reagents" (p. 188). We are bewildered by this apparent inconsistency, and are thankful to reflect upon such statements as he does not make. Among these, the most consoling is that of the re-creation of a living tissue; it is clear that although the metallic combination may be turned backwards and forwards through responsive and irresponsive stages, there is no such retransformation of the living tissues when once these have become what Prof. Bose calls "dead things." This should give him pause in his prediction that the reader will find that parallelism *complete in every detail* which, upon the strength of specious and partial resemblances, he claims to have established between the behaviour of materials living and non-living. F. G.

THE LEAD ACCUMULATOR.

Secondary Batteries: their Theory, Construction, and Use. By E. J. Wade. Pp. ix+492. (London: The *Electrician* Printing and Publishing Co., Ltd.) Price 10*s.* 6*d.* net.

MR. SWINBURNE in his presidential address to the Institution of Electrical Engineers remarked that it was wonderful that we had the lead cell at all, seeing that we owed it to a chance observation of Planté. On a perusal of Mr. Wade's book it seems even more remarkable that the "chance observation of Planté" has been developed into so indispensable an adjunct of electrical engineering. It is usually the boast of the electrical engineer that his branch of engineering can lay claim to being an exact science in the truest sense. He is able to base on a solid foundation of theory the design of a 4000 H.P. alternator or a sensitive millivoltmeter, and feel confident that the result will be what he requires. He can work contentedly with these things, because he feels that he knows to what their behaviour under different conditions is due. But with the accumulator it is different. Probably nine electrical engineers out of ten do not know what is the cause of the E.M.F. given by the combination lead / sulphuric acid / lead peroxide, but imagine that, like Topsy, "it just growed." Still less would they be able to give any plausible explanation of the frequently erratic behaviour of accumulators. This is partly due to a narrow-minded contempt for chemistry, more or less inherent in the electrical engineer in his student days, and only regretted when the time for studying first principles is past. But the ignorance must be also partly ascribed to the unsatisfactory condition of the knowledge amongst experts in the subject.

These circumstances make Mr. Wade's book all the more welcome. The author has endeavoured to set forth all that is known concerning the storage battery, and great credit is due to him for the very thorough way in which he has carried out his task. After a brief introductory chapter, the author passes to the history of the lead cell; it is noteworthy that this chapter practically resolves itself into a history of the development of the "grid" or other support for the active material, so slight is the alteration that has been made from the chemical side since the time of Planté and Faure. The tenth and final chapter, in which are described all the leading makes of cells, whether of English, continental or American manufacture, is marked by the same characteristic.

The seventh, eighth and ninth chapters deal with the manufacture, testing and use of lead cells, and these will be found very instructive, especially by those interested in the commercial application of the storage battery. In the eighth chapter the author has attempted to define the lines on which lead cells should be designed; the result is not very satisfactory, but the fault does not lie with Mr. Wade. Until theory has shown the way, design must necessarily be carried out on empirical lines, and reliance must be placed on intuitive perception of what is good and what bad. In chapter iii. Mr. Wade discusses storage cells

other than lead, and though the attempts to find some satisfactory substitute for the lead cell have been many, the results have been in all cases disappointing; it remains to be seen whether Mr. Edison's iron / nickel-oxide combination will prove any more practical than its forerunners. As yet the trustworthy information concerning its behaviour and durability is too meagre for any prophecy as to its future to be made.

We have left the contents of chapters iv. and v. to the last, as these contain what to many will doubtless prove the most interesting part of the book. In chapter iv., on the properties and behaviour of lead cells, the electrical phenomena which a complete theory of the chemical reactions must explain are described, and in chapter v. the author deals with the theories which have been advanced. The information as to the electrical behaviour is full and comprehensive, and typical curves of charge and discharge under various conditions are given. These points have been very thoroughly studied both in commercial and in experimental cells, and it is perhaps surprising that their theoretical explanation has proved so difficult. Mr. Wade's views were expressed in his paper read before the Institution of Electrical Engineers three years ago, and they are here repeated. The cycle of changes taking place on discharge, reversal and recharge is explained as being due to changes in a complex lead molecule on the one hand, and a similarly complex lead-peroxide molecule on the other. Double sulphation results from the addition of (SO_4) groups one by one (with corresponding removal of O_2 on the peroxide plate), but the process does not go on until the active material has the composition $Pb_{12}(SO_4)_{12}$ (on the assumption of initial composition Pb_{12} and $Pb_{12}O_{24}$ respectively) on both plates. When the active materials have the compositions $Pb_{12}(SO_4)_8$ and $Pb_{12}O_8(SO_4)_8$ the plates are fully discharged. If the current be now kept flowing in the same direction reversal sets in with addition of O_2 at the negative, and its removal at the positive, and this goes on until $Pb_{12}O_8(SO_4)_8$ and $Pb_{12}(SO_4)_8$ are formed; continuing the current still in the same direction O_2 is added and (SO_4) removed at the (old) negative and (SO_4) removed at the (old) positive, until finally $Pb_{12}O_{24}$ and Pb_{12} are reformed, and the cell is fully charged, but with the plates reversed.

This explanation, it is true, helps to explain some of the obscure points in the behaviour of lead and lead peroxide in the accumulator, but it is questionable whether the weight of evidence in its favour is sufficient to justify the assumptions necessary, even though these may be to some extent supported by collateral evidence of a purely chemical nature. The truth of the matter seems to be that at present we cannot go much beyond the double sulphation theory originally put forward in these columns by Gladstone and Tribe. Progress is barred, not so much by want of study of the lead cell as by want of knowledge of the general behaviour of lead compounds during electrolysis, and even by ignorance of the reactions occurring on the electrolysis of sulphuric acid. In these circumstances, we can look for little help from the dissociation theory, nor has it, as Mr. Wade remarks, thrown any light on the problems presented, and thermochemical calculations cannot be of great assistance either.

We have dealt with Mr. Wade's book at some length, but not at a greater length than its merits deserve. It only remains to give a word of praise to the illustrations, which, especially in the case of the pictures of different grids and supports, are very clearly executed, and considerably enhance the value of the book.

Maurice Solomon.

BIOLOGY OF THE LAKE OF GENEVA.

Le Léman. Monographie limnologique. Tome troisième, première livraison. Par Prof. F. A. Forel. Pp. 411. (Lausanne: F. Rouge, 1902.)

In this, the first portion of the third volume of his interesting work, Prof. Forel treats of the biology of the Lake of Geneva, and describes with his customary wealth of detail the various forms of life observed in and upon the waters of the lake. From a biological point of view, Prof. Forel divides the lake into three regions: (*a*) *littoral*, extending from the shore line down to a depth of fifteen metres; (*b*) *abyssal* (*profonde*), comprising a layer of water about two metres in depth extending from the littoral region all over the bottom of the lake; (*c*) *pelagic*, the great mass of water beyond the littoral region and above the abyssal region. The fauna and flora are classified in accordance with these three regions, and as the animals and plants exist in intimate biological relation, they form what Prof. Forel describes as "sociétés," so that there is a "société" pertaining to each region. Descriptions and illustrations are given of the methods and apparatus employed in collecting the organisms in the different regions, and in the sorting out and separation of these organisms when obtained.

The first half of the book is occupied chiefly with a full list of the organisms constituting the fauna and flora of the lake. Prof. Forel enumerates in all nearly one thousand species. Many of these, however, such as the bats and some of the birds, have no claim to be considered natives, but, like *Homo sapiens*, who heads the list, resort to the lake in search of a living. On the other hand, there are many species peculiar to the lake, among which the most interesting are those adapted to live at considerable depths. The most remarkable of these abyssal forms are the blind Crustacea, *Asellus Foreli* and *Niphargus Foreli*, but most of the groups of animals occurring in the lake have representatives in the deep fauna. Among plants, the only peculiar abyssal form is a moss, *Thamnium Lemani*, found at a depth of nearly 200 feet, yet brilliantly green.

In some groups, the lake is very rich in species, while in others it is surprisingly poor. This may be partly due to some groups having been more thoroughly studied than others.

Of the seven species of mammals noted, one, the beaver, is extinct, two, on Prof. Forel's own showing, have not yet been recorded with certainty, while three are classed as "erratic" or adventitious, leaving only the otter as a regular inhabitant. There is a long list of

birds, many of them mere visitors. Of the forty-two species of Entomostraca, only seven are recorded as pelagic, but a large number occur in the deep region.

Of the twenty-six Rotifers recorded, the majority, fifteen, are pelagic. It is probable that further work in the littoral region would considerably extend the list. Many species of Rhizopods extend into the abyssal region, and several are peculiar to it. Among the Algæ, the Diatoms are very numerous, comprising a greater number of species than any other group of organisms, while, on the other hand, the paucity of Desmids is remarkable. Only two species of Closterium represent the typical unicellular group; the only species cited as pelagic is a Hyalotheca, while the genus Staurastrum, so generally present in the plankton of the lakes in this country, is not noted at all.

It is somewhat surprising to find only two Hepatics and three Mosses in Prof. Forel's lists and no Lichens whatever. In dealing with the Mosses, the professor seems to make it a rule only to admit species which are permanently submerged, a rule which, applied all round, would greatly curtail his lists.

The second half of the book is devoted to the study in detail of the plant and animal associations of the various regions and to the discussion of many interesting problems offered by the life of the lake. Into most of these problems, concerning the origin of the various associations, the migrations of the plankton, &c., we cannot here enter, but several of the more interesting points may briefly be noticed.

Prof. Forel insists on the recent origin of the flora and fauna of the lake, in common with those of all regions which have undergone a glacial epoch. He remarks on the cosmopolitan character of the pelagic population. A remarkable fact is the occurrence of Chironomid larvæ and air-breathing Molluscs at great depths. Without any apparent modification of their structure, both these animals seem to be able to adapt themselves to the altered conditions found at the bottom in the deeper parts of the lake when casually transported thither. When brought to the surface, the air-tubes and air-cavity are found to contain water. After exposure for some time in shallow water, they resume the normal mode of breathing. Prof. Forel further points out that those Chironomid larvæ which had become adapted to breathe water would thereby be prevented from rising to the surface to pass into the winged state. He asserts that as a matter of fact they never are observed to emerge from the water except in the littoral region, and discusses the possibility of the insects breeding pedogenetically, as is known to occur with some species, but considers it more probable that they are all casually introduced.

Some notes are given of the occurrence of albino cygnets among the broods of swans on the lake. There is also a reproduction of an interesting old plate, dated 1581, from the Library of Geneva, giving sketches and notes of nineteen species of fishes frequenting the lake. Mention is made of a fungoid disease, attributed to *Saprolegnia ferax*, which attacked the pike in the lake in the years 1886 and 1887, destroying large numbers of all sizes. The work is valuable as a comprehensive summary of the biology of a large lake, and will be of much service to those who are making similar studies of other lakes.

The second and concluding part of the third volume of Prof. Forel's monograph on the Lake of Geneva will, it is understood, deal with the pile-dwellings, fisheries and other relations of man to the lake.

OUR BOOK SHELF.

A Monograph of the Land and Freshwater Mollusca of the British Isles. Vol. ii. Part viii. By J. W. Taylor, F.L.S. Pp. 52; 5 pls. col., figs. in text. (Leeds: Taylor Brothers, 1902.)

WITH the present part, this work enters on its long-awaited second volume, containing the systematic portion. The first volume was devoted to a sort of general introduction to the study of the Mollusca, with special reference to British forms, and left much to be desired; but this second section should prove of great value, seeing that for many years past the author, ably seconded by Mr. W. D. Roebuck, has been patiently amassing a large amount of very valuable information concerning the distribution and variation of the British non-marine Mollusca. So extended, however, is the plan on which the work is projected that further co-operation is invited and will, we hope, be readily given.

As compared with other works of its kind, the present one is noteworthy for the greater length at which the various details concerning each species are treated and for the introduction of new features of great importance. Anatomy receives its proper share of attention; but too much space is bestowed, and mostly wasted, on variations that are quite unimportant scientifically. In this section especially, more careful editing is required to remove the too obvious traces of mere compilation and to introduce a better sense of proportion between the different parts.

The geographical distribution of the species is, however, the strong feature of the work, and here an innovation of very great value is introduced, for, besides detailed records in the text, the range of each species in the British Isles is shown on a separate, coloured map, indicating (*a*) districts from which the author has actually seen specimens, (*b*) areas for which the species has been recorded by other observers, and (*c*) regions in which it probably occurs. To these we hope the author will add indication (say by dots) of districts formerly occupied by a species (*e.g. Acanthinula lamellata*) the range of which has become restricted in recent times. Distribution over neighbouring areas of the continent is shown on maps in the text.

The inclusion of forms entirely fossil (*e.g.* Glandina from the Eocene) is another, welcome, new departure, and here, as in the geological histories, we believe, although it is not so stated, Mr. R. B. Newton rendered some assistance (*cf. Journ. Conch.*, x. p. 74).

The illustrations in the text are mostly good, but here and there is one unworthy of the rest (*e.g.* No. 52).

Plate i., with coloured figures of Testacella, is an excellent example of tri-colour printing, but the artist must surely have had wooden models to draw from.

One would have expected to have found a more modern classification adopted than that set forth on the opening page, but what was selected should have been correctly followed. The branch Euthyneura, which was established by Spengler, and not by Lankester as stated, is not synonymous with the order Pulmonata, which is only one of its subdivisions.

These and other minor blemishes, however, do not affect the value of the work in its entirety, and when completed the author will undoubtedly have made a most important contribution to the literature on the study of our British non-marine Mollusca. $(BV)^2$.

Interest and Education. The Doctrine of Interest and its Concrete Application. By Prof. C. DeGarmo. Pp. xiii + 226. (New York: The Macmillan Company, 1902.) Price 4*s.* 6*d.* net.

THE masters in English secondary schools have in the past been a little impatient of philosophical treatises dealing with the principles underlying educational practice; they have been apt to recognise education as an art, though unwilling to give attention to writers anxious to formulate a science of education. While fond of insisting upon the value to the teacher of individuality and freedom of action, our schoolmasters have failed to understand that until they have discovered and can apply the principles of their art, they are mere empirics, each knowing only what he has learnt from personal experience. The greater attention given in America and Germany to the training of teachers has incidentally resulted in the growth of a body of able men devoted to the study of educational science. Prof. DeGarmo, of Cornell University, is one of these students of pedagogic problems, and the book before us, with its evidences of enthusiasm on every page, represents some of his recent work. Taking Schurman's dictum as his text, that "interest is the greatest word in education," he shows how interest arises among primitive men, what its object should be, how it can be made to assist in the delimitation of the curriculum, and what relation it has to methods of teaching. Prof. DeGarmo has no sympathy with those intellectual aristocrats who cherish archaic educational ideals and deny the badge of scholarship to all who do not accept their estimate of the value of Greek and Latin. He attaches as much importance to rational instruction in science as to the making of Latin verses—"the student in the scientific, the technological or the commercial course is not inferior to his brother in the arts course . . . difference is not inferiority." He quotes approvingly, too, Lord Kelvin, who has said, "the higher education has two purposes—first, to enable the student to earn a livelihood, and second, to make life worth living," and this book should greatly assist teachers so to educate their pupils as to make both these requirements possible of attainment.

A. T. S.

The Theory of Optics. By Paul Drude. Translated from the German by C. R. Mann and R. A. Millikan. Pp. xxi + 546. (London: Longmans and Co., 1902.) Price 15*s.* net.

A VERY full account of the German edition of the above work appeared in these pages rather more than two years ago (October 18, 1900), under the title "A Modern Text-book of Optics." To what was then said little need be added. Prof. Michelson, in his preface to the translation, expresses the facts when he writes, "But no complete development of the electromagnetic theory in all its bearings, and no comprehensive discussion of the relation between the laws of radiation and the principles of thermodynamics have yet been attempted in any general text in English."

Prof. Drude's book fills the gap, and we may well agree with Prof. Michelson in his opinion that by making the book accessible to English-reading students, the translators have done an important service.

The translation has been well done; to the English reader the get-up of the book has an unfamiliar and not quite pleasing appearance, due to its American origin, and the illustrations of apparatus are not as good as we are accustomed to see in books of the class, but this does not really detract from the high merit of the work.

An index, which was wanting in the German edition, has been added, but the references to original papers, especially papers of historic interest, are singularly incomplete. The book does not pretend to develop the subject from the historic standpoint, it is true, but still the omissions noted are very marked.

In spite of these, the book is of very real value, and should be found on the shelves of every physical laboratory.

Le Forze Idrauliche. By Ingegnere Torquato Perdoni. Pp. 205; with four plates. (Milan: Ulrico Hoepli, 1902.)

IN a country like Italy, where coal has to be purchased from abroad, the utilisation of natural sources of available energy is an important problem. In this volume the author gives in tabular form a list of the principal water courses of the Italian mainland, and estimates, so far as information will permit, the amount of horse-power obtainable from these (*a*) under normal conditions ("magra ordinaria") and (*b*) during the dry seasons of the year ("minima magra"), exceptional droughts being excluded. Between these two limits, there is a large amount of energy available during the greater part of the year, which might be utilised if provision were made for supplying the deficiency during the dry months, and one method suggested is to apply this water power to electric traction on the railways, supplementing it in the summer by the use either of ordinary locomotives or steam engines at the generating stations. Of other sources of energy, the sea with its tides and waves is considered, and even glaciers are mentioned in connection with the property that a cold body may act as a store, if not of *energy* (as the author implies), at any rate of *availability*. This distinction between energy and availability might with advantage be pointed out clearly in the introduction, which deals with "the unity of concepts in modern physics," but in which the part devoted to matters thermodynamic is suggestive of Carnot's *caloric* theory of the motive power of fire rather than of the second law as modified by Clausius.

De Ether. By Dr. V. A. Julius. Pp. 56. (Haarlem: De Erven F. Bohn, 1902.)

L'Etere e la Materia ponderabile. By Ingegnere M. Barbèra. Pp. viii + 134. (Turin: Bertolero, 1902.)

THE first of these pamphlets consists of a discourse given to a vacation class of teachers in April, 1902, shortly before the death of the author. It was published at the request of many members of the class, and is as good a general historic account as could possibly be given in so short a space of our knowledge of the ether, considered with regard to optical phenomena, starting with the corpuscular theory of Newton, and tracing the various theories of Huyghens, Fresnel, Cauchy, Lord Kelvin, Maxwell, Fitzgerald, Larmor, Lorentz, and other writers.

Signor Barbèra's book is of a very different nature. In it he endeavours to account, without the use of mathematical formulæ, for the whole of the phenomena of modern physics and physical chemistry, on the supposition that the ether like matter consists of an aggregate of material particles, and that it differs from matter only in its very small density and very great elasticity. In the fifth paragraph he discusses the propagation of transverse waves on the hypothesis that the ether is a *fluid*. The motions which he describes in this connection are, however, well known to readers of hydrodynamical text-books as those produced by a sphere moving or oscillating in liquid. The book is up-to-date so far as the inclusion of recently discovered physical phenomena is concerned, but no theories of the ether can be adequately discussed in a pamphlet of this size and character, however carefully written.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Sir Edward Fry on Natural Selection.

I ask leave to make a few observations on Mr. Galton's letter under the above heading which appeared in your issue of February 12.

In my papers on the age of the inhabited world and the pace of organic change in the *Monthly Magazine* for last December and January, I had a passage on the difficulty which appeared to me to exist in conceiving mimetism to have been produced by the gradual accumulation of minute points of likeness. On this Mr. Galton observes that "two objects that are somewhat alike will be occasionally mistaken for one another when the conditions under which they are viewed are unfavourable to distinction." If by "somewhat alike" Mr. Galton means have some point of likeness, however minute, then the proposition would refute my objection; but it would, as I think, be manifestly untrue. If, on the other hand, by "somewhat alike" be meant a considerable likeness, then the proposition is manifestly true, but leaves unanswered the difficulty on which I have dwelt, viz. the difficulty of seeing how natural selection could have helped the organism to convert minute points of likeness in the midst of unlikeness into such a preponderance of likeness as to produce deception.

Mr. Galton has illustrated his point by the fact that "i" may often be mistaken by the beholder for "l," "k," or "h." But here he starts with an obvious and considerable likeness, and the question is, how could that degree of likeness be reached by natural selection?

Let us take two sheets of paper, the one a *tabula rasa*, the other covered with a thousand dots arranged so as to produce a highly complicated pattern. Then let dots appear successively, but sporadically, on the white paper in places where there are dots on the other paper, until, in the end, the two papers are indistinguishable. It seems to me to be obvious that for a long while no eye would mistake the one paper for the other; but that, as the process goes forward, a point will be reached where an occasional mistake will occur under conditions unfavourable to distinction. Now I agree that it is conceivable that from this point forward natural selection may operate, but as to the whole interspace between the first minute change that deceives no one to the point of first deception, it appears to me plain that natural selection cannot operate at all, and that the theory of the accumulation of minute variations, therefore, fails to account for the facts of mimetism in insects and other organisms.

If the two suggestions of sudden and great variation on the one hand, and of the slow accumulation of small variations on the other be considered as the possible explanation of the facts of mimetism, I cannot but think that the latter will be found far more probable than the former; and therefore, whilst willingly admitting the great weight to be attributed to the opinion of Mr. Galton on the subject, I remain unconvinced.

But suppose that on this point I am wrong and Mr. Galton is right, does he not judge my argument with undue severity when he treats it as "so faulty as to seriously compromise the value of the memoir as a whole"? My observations on mimetism are not the basis of my argument, which is a collection of facts which appear to show the existence of sudden and heritable variations. They are a part, and a separate part only, of an argument that the accumulation of minute variations will not account for some known facts attributed to it. The inculpated paragraph may be struck out of my paper, and all the rest will stand unaffected. Even if this error, if error it be, has compromised not a single passage only but the whole of my paper, I am glad to find that Mr. Galton is in sympathy with its general purport, and I thank him for the courteous language which accompanies his condemnation of my lapse. Edw. Fry.

Failand, February 23.

The Assumed Radio-activity of Ordinary Materials.

With reference to Mr. Strutt's recent article and Prof. J. J. Thomson's letter on this subject, may I venture modestly to urge that it may be well to consider whether the condition set up in air to which attention is directed be not the outcome of the occurrence of a minute amount of chemical change of an ordinary character—whether it be not a sort of Russell effect on an infinitely minute scale, detected by an infinitely delicate test? That oxidative change is in continual progress, I imagine, is the belief of everyone who has paid the slightest attention to the subject; and that leaf surfaces—if not waterfalls—are the certain seat of such changes may be regarded as unquestionable. Those of us who require something more than an attitude of papal infallibility in proof of a scientific proposition would like to see the old love honourably retired before the new one is accepted in society. Henry E. Armstrong.

The Dissociation Theory of Electrolysis.

In a recently published "Text-book of Electrochemistry," by Svante Arrhenius, and translated by Dr. McCrae, I find on p. 114 of the translation the following statements:—

"Even when working with polarisable electrodes . . . the smallest fall of potential is sufficient to cause a current in the liquid. This fact was proved by Buff with currents so small that it was only after months that a cubic centimetre of explosive mixture was obtained. According to this the very smallest force is sufficient to split the molecules of the Grotthus chain . . . Faraday's view is therefore incorrect. The radicles of the salt molecule cannot be held together by a force of finite value."

The ideas of current and electromotive force are here rather mixed, but obviously the passage refers to a very necessary part of the foundation of the dissociation theory of electrolysis, viz. that a minute E.M.F. can evolve in the free state the ions of an electrolyte the heat of combination of which is considerable.

On referring to Buff's papers (*Lieb. Ann.*, lxxxv. p. 1 and xciv. p. 1), I find no mention of an evolution in the manner described of any explosive mixture whatever; taking this to mean free oxygen and free hydrogen evolved simultaneously by an E.M.F. less than that of one Daniell's cell. Indeed, towards the end of his second paper, Buff incidentally states that a single cell produces merely a polarisation which almost stops the current.

Surely in the attempt to found a theory in opposition to that of Faraday some modicum of care should be taken to verify the sources of information.

In "Outlines of Electrochemistry," by Prof. Harry C. Jones (1901), we find at p. 15 the same kind of statement, that the dissociation theory accounts for, and is founded on, experimental evidence, showing that "a very weak current" can decompose water and set free its constituents simultaneously. Here also the word "current" is used, though "E.M.F." is apparently meant.

No reference is given, but the statement occurs in a discussion of the well-known Clausius theory. In his description of this theory (*Pogg. Ann.*, ci. p. 338), Clausius certainly does not mention, and apparently did not believe, that any such phenomenon could occur.

It would be interesting to know if anyone has ever observed it.

At all events, the acceptance of the theory in question is certainly not encouraged by an encounter with such serious errors in the description of experiments put forward as its foundations. J. Brown.

Analysis of the "Red Rain" of February 22.

Some of your readers will probably be interested to know something of the nature of the muddy rain which fell here on Sunday, February 22. A sample of the downfall, caught in an open field between 10 a.m. and 12 noon, was brought to me to examine, and particulars of the partial analysis of the suspended matter which the water contained are subjoined. The large percentage of organic matter seems to me to be the most remarkable point in the analysis, and I regret not having had time to make a separate investigation of this. A rapid examination of the physical proper-

ties of the sediment, or mud, which I made, seemed to indicate that the organic matter was condensed hydrocarbon gases, or condensed volcanic vapours (such as one might expect to be evolved unburnt in a very large volcanic outburst). The sediment seems to be terrestrial, as the large amount of organic matter, coupled with the small amount of iron found, prohibits the theory of a meteoric origin.

The rain water contains 37·0 grains of suspended matter, or mud, to the gallon.

The analysis of the suspended matter, dried at 100° C., is as follows:—

Organic matter (loss on ignition) ...	36·4	per cent.
Silica	45·6	,,
Alumina and oxide of iron... ...	13·6	,,
Magnesia	2·4	,,
Unclassified	2·0	,,
	100·0	,,

Buckfastleigh, March 2. ROWLAND A. EARP.

Proof of Lagrange's Equations of Motion, &c.

IN your issue of January 29, Mr. Heaviside put forward a demonstration of Lagrange's equations of motion which appears invalid. As neither his interpretation of Newton nor his argument based thereon was stated with sufficient clearness to enable a critic to locate the weak spot without running serious risk of misinterpreting him, it seemed better in the first instance to point out a well-known case in which precisely similar reasoning would lead to Lagrange's equations of motion where they are known to be untrue (the reason, and a proper remedy, being also generally known). This I did in your number of February 19; his reply, in the same number, is to the effect that he does not intend to uphold the truth of Lagrange's equations in such a case. It is not, however, logically permissible for anyone to escape the inconvenient consequences of his own argument in such a fashion.

Possibly Mr. Heaviside has not grasped my point. If the argument he puts forward on p. 298 is valid, I am unable to see any point at which the following can without inconsistency be alleged to fail:—"In the case of a rigid body rotating round a fixed point with angular velocities ω_1, ω_2, ω_3 about its principal axes the kinetic energy T is a homogeneous quadratic function of the ω's, with coefficients which are constants. This makes

$$2T = \omega_1\frac{dT}{d\omega_1} + \omega_2\frac{dT}{d\omega_2} + \omega_3\frac{dT}{d\omega_3} \qquad (8)$$

therefore

$$2\dot{T} = \omega_1\frac{d}{dt}\left(\frac{dT}{d\omega_1}\right) + \dot{\omega}_1\frac{dT}{d\omega_1} + \ . \ . \ . \qquad (9)$$

But also by the structure of T,

$$\dot{T} = \dot{\omega}_1\frac{dT}{d\omega_1} + \dot{\omega}_2\frac{dT}{d\omega_2} + \dot{\omega}_3\frac{dT}{d\omega_3} \qquad (10)$$

So, by subtraction of (10) from (9)

$$\dot{T} = \omega_1\frac{d}{dt}\left(\frac{dT}{d\omega_1}\right) + \omega_2\frac{d}{dt}\left(\frac{dT}{d\omega_2}\right) + \omega_3\frac{d}{dt}\left(\frac{dT}{d\omega_3}\right) \qquad (11)$$

and therefore, by Newton, the torque about the first axis is the coefficient of ω, *i.e.* $A\dot{\omega}_1$, and similarly for the rest."

There is no step in his demonstration which requires that the coordinates should be "proper Lagrangian coordinates within the meaning of the Act"; in the proof usually given there is such a step.

It is with great diffidence, lest I may do Mr. Heaviside injustice through misinterpreting him, that I now venture to express the conjecture that in his argument he may possibly have failed, as is sometimes done [by Maxwell, for instance, "Treatise," second edition, § 561, equations (5)], to distinguish between the displacements which a material system actually receives during its motion and displacements which are perfectly arbitrary subject only to the geometrical connections of the system, and have thus confounded the equation

$$X_1 v_1 + \ . \ . \ . \ = \left(\frac{d}{dt}\frac{dT}{dv_1} - \frac{dT}{dx_1}\right)v_1 + \ . \ . \ .$$

which expresses that the rate at which work is done by the forcives is equal to the rate at which the system gains kinetic energy, with the very different one

$$X_1\delta x_1 + \ . \ . \ . \ = \left(\frac{d}{dt}\cdot\frac{dT}{dv_1} - \frac{dT}{dx_1}\right)\delta x_1 + \ . \ . \ .$$

in which δx_1, &c., are arbitrary displacements as above. When the latter equation is established, Lagrange's equations follow at once, but Mr. Heaviside has made out no case for deducing them from the former. In every case, as in the example I cited, the right-hand member of the former equation can be written in the form

$$v_1\phi_1(x_1, v_1, \dot{v}_1, x_2, v_2, \dot{v}_2, \ . \ . \ .) + \ . \ . \ .$$

in an infinite variety of ways, and accordingly it is sufficiently obvious that there is no warrant for stating that the force on x_1 is the coefficient of v_1 in any one such form more than in any other. Samples of expressions which might thus be wrongly obtained for the torque about the first axis in the instance alluded to are

$$A\dot{\omega}_1,\ A\dot{\omega}_1 - (B-C)\omega_2\omega_3,$$
$$A\dot{\omega}_1 + (B-C)\omega_2\omega_3,\ A\dot{\omega}_1 - (B\omega_2{}^3 - C\omega_3{}^3)/\omega_1.$$

For the simpler case of a particle moving in a plane, one could thus obtain, for example, the equations,

$$X = m(\ddot{x} - k\dot{y}),\ Y = m(\ddot{y} + k\dot{x}),$$

where k is any quantity whatever.

In short, the latter of the two equations compared above differs from the former in being equivalent to a set of independent equations equal in number to that of the coordinates of the system.

Similar remarks apply, of course, to his treatment of the question of an elastic medium, p. 297.

That the Principal of Energy, or of Activity, does not by itself afford a sufficient basis from which to formulate the fundamental equations of dynamics in any form whatever is admitted almost universally; from Mr. Heaviside's letters it appears at least doubtful whether he is willing to agree with this general and well grounded opinion; he has advanced no valid argument against it, however. W. McF. ORR.

February 22.

A FEW weeks ago you published in a letter from Mr. Heaviside a proof of Lagrange's equations of motion of a system of bodies. I must confess that I in common with others swallowed it, but I have now come to the conclusion that the proof, though doubtless admirable as an example of the power of the "Principle of Activity," does not prove Lagrange's equations. In fact, if q be a coordinate, $\dot{q}$ the corresponding velocity, and Q the corresponding force, we have the result

$$\Sigma\dot{q}\left\{\frac{d}{dt}\frac{\partial T}{\partial \dot{q}} - \frac{\partial T}{\partial q} - Q\right\} = 0$$

for any possible motion of the system. But we are not entitled to equate the quantities in the brackets to zero, for *these are not independent of* $\dot{q}$. The "proof" is, in fact, merely Maxwell's well-known but fallacious proof, simplified by going direct instead of *viâ* Hamilton.

Cambridge, February 28. R. F. W.

Genius and the Struggle for Existence.

PERMIT me to point out that Dr. A. R. Wallace's statement (p. 296), "the comparatively short lives of millionaires," is not supported by facts, at any rate by those for the last three years.

The following has been obtained from the details concerning estates on which death duties were paid. Nine millionaires died during 1900, leaving in the aggregate 19 millions. The average age of these nine testators is seventy-four—the youngest was fifty-nine and the oldest ninety-one years.

During 1901, we find that the deaths of eight millionaires are recorded, whose joint estates were valued at 10½ millions. In this case too, we find that the average age is above the allotted threescore years and ten, being seventy-two. The

youngest in this year was fifty-three, and the oldest—Baron Armstrong—was ninety.

Last year—1902 the same story is repeated. Five millionaires died in 1902, and their average age is seventy-eight. It is also worth remarking that if our inquiries are carried further, it will be noticed that longevity is a striking feature of those whose estates are valued at between 500,000*l*. and 1,000,000*l*.

It seems to me that one might have expected this state of things to exist, if we consider how the wealthy—through their wealth—can secure the advantages of change of scene, change of climate, scientific progress, and last, but not least, the aid, skill and advice of our greatest doctors and surgeons. One would have liked to take up other points, but I fear I have already taken up too much of your valuable space. S. IRWIN CROOKES.

Secondary and Technical Schools, Clay Cross, Chesterfield, February 17.

IN some respects it appears to me that the excellent remarks of Sir Oliver Lodge and Mr. A. R. Wallace (NATURE, lxvii. pp. 270, 296) leave this difficult subject in an unsatisfactory condition.

All inquirers have perceived that great men are of two types, and it would conduce to clear thinking if we could accustom ourselves to classify them under different names. To define them exactly is impossible, for no man of great genius is without talent, and no man of great talent is without some genius.

The first class, to which I should prefer to restrict the name genius, may be described primarily as men of fine, delicate, sensitive, impressionable constitution, and strong, restless innate tendencies which appear early in life, as a rule, and take their own shape. These men work energetically, often at high pressure, and in general die comparatively young, or at least do not often reach a robust old age. They are fearless rather than circumspect, have the ability and courage to open out in new directions of thought and action, are creative, original, daring, and possess either an exquisite sensibility or a wonderful and tenacious faculty of logical thought. They are, as it were, impelled from within, and are thus able to resist the almost overwhelming influence of social example, and the ties of relationship, exhibiting, for the most part, more independence than their times can tolerate or understand. They introduce most of the new ideas into the world, and touch nothing they do not transform. They are always men of strong practical feeling in their own special vocation, but scarcely ever practical in the sense of turning every opportunity to their own advantage. Indeed, the height to which they soar is largely due to their detachment from worldly interests and conventions, and their lack of regard for self, though this may be consistent, and is often found in conjunction, with excessive vanity and egotism. They take a sympathetic interest in human affairs, and are most commonly liberal in sentiment, but their actions are often narrow and sometimes indefensible. Frequently they are simple, direct, guileless, not so much unversed in as opposed to the diplomatic ways by which men succeed; but contact with the world is apt to spoil them, and their very logic leads them into extremes. Despite abundant energy, their powers of resistance are not great, and they most often reach high eminence in music, poetry, painting, philosophy and science, where activity lies somewhat remote from the tension and bustle of practical life. They are said to be inspired because of the enthusiasm, and unconscious working, of their minds.

The second class I would describe as men of talent. When preeminent they exhibit striking aptitude in learning and in imitation, and develop extraordinary powers of work. They are generally men of strong, vigorous build, firm mind and healthy body. They are, accordingly, marked by general sanity of ideas, preferring to think and act in conformity with prevailing conventions rather than to startle men with novel views. Except perhaps in their own particular sphere of activity, they are conservative in character. They possess a clear conception of the value of this world's goods and graces, accumulate honours, and become, in general, more reputable than illustrious. They do the bulk of the world's hard mental work, and are more concerned to protect and improve existing institutions than to seek new methods or discover new paths. When they do achieve greatness it is more by virtue of immense knowledge and systematic exposition, or of amazing industry and technique, than of original and independent views. What Galton says of English judges applies with all its force to men of talent in general: they "are vigorous, shrewd, practical, helpful men; glorying in the rough-and-tumble of practical life, tough in constitution and strong in digestion, valuing what money brings, aiming at position and influence, and desiring to found families."

As described, these are of course ideal types, to which actual men more or less approximate. But they are well enough distinguished in nature for mutual antagonism. The man of talent is apt to laugh at the genius; and the genius too often sneers at the man of talent. The one is pushing, the other retiring; the one looks for and obtains immediate reward, the other works for fame and posterity. Compared with the man of talent the genius is a rare phenomenon. But this may be because so many geniuses are sacrificed before their activity has produced lasting results, for the existing environment is not favourable to them. As typical of the genius I would name Chopin, Mozart, Beethoven, Raphael, Goethe, Shakespeare, Keats, Shelley, Kepler, Galileo, Newton, Faraday, Descartes, Spinoza; and of the great men of talent Aristotle, Velasquez, Virchow, Hegel, and, indeed, those numerous men who have attained eminence rather through enormous receptivity and power than by acuteness and creative faculty.

These types once fairly discriminated, it is not so difficult to determine their relation to the struggle for existence. Great men, in proportion as they approach the second type, are the more clearly useful in the immediate needs of life, and this, in plain language, is the only usefulness conserved by natural selection. Whoever supposes that natural selection is a being with eyes directed towards the future has wholly misconceived it. Men of genius not only leave few, inferior, or no offspring, but too often find it difficult to live. And explain it how we will, the public opinion that neglects men of genius during their lives is natural selection. Genius never conquers except when the ideas and works to which it gives origin are taken up and put to practical use by men of the second type. If the ideas are beyond the men of talent, they are as much neglected as the geniuses, until such time as the world has made progress in its own slow way. There are many ideas now in printed books which are waiting for recognition by men of talent. Much of the work of genius has very little bearing on the struggle for existence. Music and painting, for example, except in so far as they are a source of profit to instrumentalists and collectors, and to teachers of these arts, do little more than give pleasure and consolation mostly to those who seek refuge from the struggle which, though concealed by many conventions, is real and searching enough beneath the surface of civilised life. The error lies in supposing that everything comes into existence by virtue of natural selection, when in fact natural selection is only a convenient expression to sum up the action of causes which conduce to survival and persistence. In nature there is great variety, and genius, so far, is one of the varieties which often recur, but scarcely ever survive even for two generations. It is a rare and delicate thing, and the utmost we can hope for it is that endeavours may be made to collect and preserve it like some hot-house plant, in order that it may suggest combinations which men of talent may put to practical account.

The position of the second type in the struggle for existence is beyond doubt. The stability of a country and its place among the nations depend upon the number and ability of men of this stamp. They obtain rewards precisely because of their usefulness. They found families by reason of their strength and virility, and their steadfastness, cheerfulness and conservatism of character are as much the expression of their bodily make as the instability and originality of the man of genius are the expression of his keen sensibility, and his daring suggestions a proof of bodily discomfort and profound dissatisfaction with the conditions of life and knowledge.

But we are only on the verge of these studies, which are hardly yet within the reach of scientific method, and we have acquired very little insight into the collective action of

natural selection in preserving nations. Our gaze is too intently fixed on the individual struggle, and we are more ready to revert to old abstract notions of inner springs and guides, set for some noble and unknowable purpose, than to develop the one fruitful idea of progress by the natural and predictable interaction of parts. ARTHUR EBBELS.

February 16.

THE ORGANISATION OF FISHERY RESEARCH.[1]

IN August, 1901, a committee, since known as the Committee on Ichthyological Research, was appointed by the Board of Trade in order "to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland, and in particular whether the object in view would best be attained by the creation of one central body or department acting for England, Scotland, and Ireland, or by means of separate departments or agencies in each of the three countries." The report of this committee, together with the minutes of evidence laid before it, has now been published.

The appointment of a committee of inquiry by Government is, I am afraid, generally regarded as having the effect of postponing, or even avoiding, any effective action on their part. In the present case, however, we have the somewhat exceptional situation of real action being taken whilst the inquiry was still in progress, and that action in a direction which is, to some extent, at variance with the course eventually recommended by the committee. For whilst the Ichthyological Committee were still engaged in hearing the evidence of experts of various degrees of authority, and by all the subtleties of cross-examination causing them to commit themselves—as is plainly indicated in the evidence of most of the witnesses—to statements which, after a little reflection and in more collected and rational moments they would rather have expressed differently, the Government decided to take part in the scheme of international investigations which was receiving somewhat rough treatment at the hands of the committee, and persuaded Parliament to vote considerable sums of money for that purpose. The Government are to be congratulated upon having taken definite practical action, even though a minor result of that action has been to cause the report of their Ichthyological Committee to be brought, as it were, with but enfeebled vitality into the world.

The question referred to the committee was, nevertheless, one of considerable importance, and their answer to it—if not of immediate moment—will probably be not without influence in the future. In a general way, the question how the State or local authorities can best assist scientific research as applied to fisheries is quite simply answered by saying that they can do so by supplying the most capable and trustworthy scientific men whose services they can obtain with the necessary funds to carry out such research. The only real difficulty is to find some scheme of organisation which will ensure that the men employed are both naturally and by experience and training the best fitted for the work, that thorough, accurate and really scientific workers are distinguished from such as are ostentatious and superficial, and that those failing to maintain their efficiency, or to carry out the work assigned to them, are speedily eliminated.

Two other matters of importance are, however, involved in the terms of reference of the committee. In the first place, what should be the exact relations existing between the men charged with carrying out scientific research and those whose duties are connected with fishery administration; and, in the second place, to what extent is it advantageous that the researches carried on in different parts of the United Kingdom should be placed under one central control.

On the subject of the relations of the administrative and scientific departments, the committee express a quite clear and definite view. They are of opinion that the responsibility for and the control of the scientific investigations should be in the hands of the central administrative authority, and that the most important of the researches should be directly carried out by this authority. In suggesting a new arrangement for England, they, however, propose the establishment of a central council, composed, in approximately equal numbers, of administrative and scientific men, whose duty it should be to advise the administrative authority (Board of Trade) on all matters concerning scientific research. No provision is suggested by means of which this council could enforce its decisions.

In my opinion, it is open to the gravest doubt whether such a direct control of scientific work by an administrative body is likely to lead to satisfactory results. The trustworthy information and assistance required by the administrative body are, I feel sure, much more likely to be obtained from a more independent scientific authority acting as advisers to the administrators, an authority the preponderating influence of which is in the hands of recognised men of science. Such an arrangement will render the selection of capable naturalists far more probable, and will ensure the naturalists being in a position to give that complete concentration of their whole energies upon the problem in hand which is so absolutely essential to successful scientific work. The claims of administration are immediate and pressing, and when they are combined with the claims of scientific research, experience has repeatedly shown that the latter are bound, sooner or later, to take a secondary place. Huxley's experiences as an inspector of fisheries are a sufficient illustration of this point.

The objection urged by the opponents of the view here advocated is that the method is less likely to lead to immediate practical results. Unfortunately, there is no short and easy road to results which are sound and scientific, and the adage "More hurry, less speed" is, I fear, more than usually applicable to work of this kind.

On the second question—a question to which the attention of the committee was particularly directed—namely, to what extent there should be central control of the investigations throughout the United Kingdom, the committee also make a definite recommendation. Recognising the fact that separate administrative authorities are already established in England, Scotland, and Ireland, and in view of their opinion that the scientific investigations should be controlled by the administrative authority, the committee consider that the researches in the three portions of the kingdom are best kept separate. In order, however, to secure some measure of uniformity of action amongst the three bodies, they propose the establishment of a quarterly conference of experts representing the English, Scottish, and Irish departments. But there seems little likelihood that such a conference, which, as in the case of the English council, it is not proposed to endow either with authority to enforce its decisions or with any power of action of its own, would be an instrument of much effective value. The scheme is in part the result of a desire, with which I entirely sympathise, to ensure to the workers the maximum of freedom and individual initiative, combined with such centralisation as shall prevent undue or unnecessary waste of energy. But would not these objects be attained more effectually

[1] Report of the Committee on Ichthyological Research. (London: Eyre and Spottiswoode, 1902.) Price 4s. 1d.

and simply by the appointment of a single individual, in whom responsibility could be fixed, and under whose general direction the heads of the scientific departments in the three portions of the United Kingdom would act, a considerable measure of individual authority and initiative being at the same time accorded to each?

Whatever scheme may be adopted, it seems to me to be the duty of all naturalists to insist that the preponderating control of the investigations, as I have already urged, shall be in the hands of recognised men of science, for unless this is so there can be no guarantee that they will be carried out by scientific methods and with that accuracy and thoroughness without which no results of any permanent value can ever be obtained.

E. J. ALLEN.

MAGNETIC WORK IN NEW ZEALAND.

THE "Report of the Department of Lands and Survey, New Zealand," for 1901–2 contains an account of the new magnetic observatory erected in Christchurch,

FIG. 1.—Magnetograph House.

New Zealand, and of the magnetic work to be carried on there under the direction of Dr. Coleridge Farr. The site of the observatory buildings in Hagley Park appears, from the illustrations in the Survey "Report," to be one of considerable natural beauty. It would also seem to be very suitable from a magnetic standpoint, if we may judge from the preliminary survey carried out by Dr. Farr in the neighbourhood of Dunedin, Invercargill, Nelson and Christchurch. Of all the districts examined, he found the vicinity of Christchurch the most free from local disturbances.

The observatory consists of three separate buildings, externally of the Swiss chalet type. Photographs of two of these are here reproduced from the Survey "Report." Fig. 1 shows the magnetograph house, or, to be strictly accurate, the superstructure above the underground cellar in which the magnetographs are lodged. Fig. 2 shows the office buildings, which also serve to accommodate a seismograph. The third building, not shown here, serves for the taking of the absolute magnetic observations.

The magnetic equipment of the observatory consists of a self-recording magnetograph by Adie and a unifilar magnetometer and dip circle by Dover, all of the ordinary Kew pattern, and examined, prior to their dispatch to New Zealand, at the National Physical Laboratory (Kew Observatory). In addition, Dr. Farr has temporarily the loan of a second unifilar and dip circle belonging to the Royal Society, intended primarily for survey work. Besides the magnetic instruments, the observatory possesses a Milne seismograph, a Kelvin water-dropper and two portable electrometers, for determinations of atmospheric electric potential, and a "dissipation apparatus" of the type invented by Elster and Geitel for determining the rate of loss of electric charges from an insulated body.

After the arrival of the magnetograph in New Zealand, Dr. Farr had the clock modified so as to allow of rapid as well as slow rotation of the drum carrying the photographic paper. This slight modification—which has been made independently by the directors of the Melbourne and Mauritius Observatories—admits of open time-scale traces being obtained as satisfactorily with the ordinary Kew pattern magnetograph as with the newer types by Eschenhagen and others. This modification has allowed Dr. Farr to participate fully in the international scheme of magnetic observations agreed on in connection with the present German and British Antarctic expeditions. In fact, during the call of the British vessel, the *Discovery*, at New Zealand, he arranged with Commander Scott an extension of the scheme of rapid registration, which it is hoped may increase its usefulness. The modification of the clock presented Dr. Farr with an opportunity of an unexpected character, of which full use was made. Zealously aided by his assistant, Mr. Skey—at what must have been considerable personal inconvenience—he succeeded in getting a practically continuous quick-run record for eighty hours during the occurrence of a succession of earthquake shocks. Part of one of the magnetic curves is reproduced in the "Report," showing a curious sinuous trace, and a complete comparison of the corresponding records from the magnetograph and seismograph may be expected to elicit valuable information as to the nature and cause of the movement of magnets at times of earthquake. The frequent repetition of such an opportunity is, perhaps, hardly to be desired, but there can be no doubt that in New Zealand, at least, the combination of magnetic and seismological investigations is a happy one.

Previous to the existence of the new institution, there was in the whole of Australasia only one magnetic

FIG. 2.—Office and Seismograph Room.

observatory, that at Melbourne. This fact and the general scarcity of such observatories in the southern hemisphere make the observatory at Christchurch of

much more than local importance. It has already afforded the magnetic staff of the *Discovery* a most valuable opportunity of comparing their instruments and practising their use in southern latitudes, of which they fully availed themselves, and when it comes to dealing with the magnetic data of the Antarctic expeditions, the Christchurch records should prove invaluable.

The public spirit and the appreciation of scientific aims shown by the New Zealand Government in providing the necessary funds for erecting and maintaining the observatory is of happy augury. It shows that war is not the only department in which the colony is anxious to come to the front.

Though hardly referred to in the "Report," mention may also be made of the fact that, prior to the erection of the observatory, Dr. Farr took magnetic observations with the instruments lent by the Royal Society at about 150 stations scattered over New Zealand, about half in each of the two principal islands. This constitutes an important contribution to the complete magnetic survey of New Zealand, which Dr. Farr puts forward as part of the programme which he intends to prosecute as circumstances allow. The objects which Dr. Farr has in view will meet with warm sympathy from all interested in the extension of our knowledge of terrestrial magnetism, and it is to be hoped that his efforts will meet with the continued support necessary for their complete realisation.

CHARLES CHREE.

THE KEARTON SELBORNE.[1]

GILBERT WHITE'S famous natural history classic has already seen something over eighty editions, and the appearance of yet another may be taken as a sure indication that its popularity shows no signs of waning. Indeed, in these days of "nature-teaching," it is quite likely to become, if possible, more widely read than ever, since there are few works in the English language better calculated to show the value of the intelligent use of the eyes or better suited to aid in the cultivation of the powers of observation. If anything could increase the popularity of one of the most popular books in the world, it would be the addition of illustrations of a modern type, faultless in execution and appropriate in subject. To furnish such pictures, no living artists, we venture to say, are better qualified than the Messrs. Kearton. Their success in this particular instance speaks, as usual, for itself; and we shall perhaps best serve the interests of both artists and publishers if we ask those of our readers who may be disposed to doubt our words to judge for themselves.

It should, however, be stated that this edition of White is a low-priced one, intended for the general public, and in no sense an *édition de luxe*. It is of small size and printed in small type, and most of the illustrations are therefore of necessity also on a rather microscopic scale. In the case of views of the village and the neighbouring country, such as that of old cottages on p. 88, this detracts but little, if at all, from their effectiveness; but it must be confessed that some of the photographs of bird-life, such as the one of an osprey and its nest on p. 78, would have been improved had it been practicable to reproduce them on a somewhat larger scale.

In his introduction, the editor claims that the illustrations are in closer touch with the spirit of the author than any which have previously appeared, and this we can fully endorse. What, for instance, could better illustrate White's observations on the young cuckoo and its foster-parents than the exquisite photograph on p. 130 of a sedge-warbler watching one of these usurpers which has expelled the rightful occupants of the nest? Or what could be more appropriate to the author's account of the Selborne ring-ousels than the illustration (herewith reproduced) of these birds feeding their young?—an illustration actually taken in the Selborne country, which cost the Messrs. Kearton at least a week's watching to obtain. At the risk of being considered hypercritical, we cannot, however, refrain from mentioning that the photograph of swallows on a telegraph-wire (p. 139) is somewhat of an anachronism in an eighteenth-century work. Again, on p. 35, a figure of harvest-mice and their nest would have been much better than the one of common mice; but perhaps to obtain the former was impossible even to a Kearton. We also think that a photograph of a fallow-buck with fully developed antlers should have replaced the one on p. 27, in which these appendages are less than half-grown. In other respects, we have nothing but commendation to bestow on the illustrations, both as regards subject and execution.

Although brief, Mr. R. Kearton's notes are very much to the point, and give all the information required by ordinary readers in regard to modern emendations on White's zoological determinations. We note, however, that the editor has not seen fit to follow modern views in

FIG. 1.—Ring-ousels eeding their young. From the Kearton "Selborne (Cassell and Co., Ltd.)

regard to the nomenclature of bats. The book appears singularly free from misprints (although we notice an unfortunate one on p. xiv.) and is admirably got up. It would be an insult to say that it is calculated to add to the Kearton reputation, since this is an impossibility, and we can do no more than commend it to the attention of all in search of an attractive gift-book.

R. L.

[1] "The Natural History of Selborne." By Gilbert White. With notes by R. Kearton and illustrations by C. and R. Kearton. Pp. xvi + 294. (London: Cassell and Co., Ltd., 1902.) Price 6s. 6d.

RECENT CONFERENCES BETWEEN SCIENCE MASTERS AND EXAMINERS.

DURING the past year or so signs have not been wanting that the unfortunate separation between teaching and examining, which has so often been deplored, is likely, before very long, to be either mended or ended. And we think that both the representatives of the Universities and the subcommittee of the Public School Science Masters' Association are to be congratulated on the new departures that were made at Cambridge on Saturday, February 7, and Oxford on Saturday, February 14, when they met at conferences summoned by the Vice-Chancellors of the respective Universities, to consider the question of entrance scholarships in the natural sciences given at the several

colleges in Oxford and Cambridge, from the point of view of the teaching of science in public schools. For, though the representatives of the Universities did not accept all the proposals brought forward, they did accept a large proportion of the chief of them, as, for example, the proposal to limit the number of chief science subjects offered by any candidate to two, and another requiring all candidates offering geology, or biological subjects to show an acquaintance with the elements of chemistry and physics, and thus a real beginning in the direction of greater cooperation was made.

We do not, however, attach so much importance to the results attained by these first conferences as we do to the fact that the conferences were held at all. For we feel sure they will be followed by others, that the science masters will be imitated by the masters of other departments, and that whatever the immediate results may be, however great or however small, we might almost say however good or however bad, they will sooner or later and we think sooner—do much to disentangle many knotty questions, and by generally improving the relations of those who teach and those who examine, do good work both for individuals and for the State, to both of whom the advancement of education is admittedly of vital importance. We hope and believe, moreover, that now the representatives of the colleges at Oxford and Cambridge have led the way in thus conferring directly with the assistant masters, who, in the nature of things, must do most of the actual teaching in the schools, other public bodies concerned with education, such as the University of London and the Civil Service Commissioners, will not be backward in promoting similar conferences whenever there may seem to be a reasonable prospect that they may prove useful. Some examining bodies in the past have been too timid in the matter of reform, and have shown far too much fear of giving the schools a lead, forgetting that the evil of going too slowly may be even greater, at times, than that of going too fast. Conferences like those we are now recording should be immensely helpful to such conservative bodies by giving them the best possible opportunities of getting into touch with the actual educators.

Hitherto, circumstances have tended far too much to make the teachers in schools look upon examiners solely as critics rather than as friends and colleagues. The recent action of the University of London in appointing schoolmasters to examine schoolboys, the proposed consultative committee to assist the War Office on educational questions, and these recent conferences at the old Universities, give good ground for hoping that this state of things is about to pass away, and that teachers and examiners will soon be pulling together more universally than they have done hitherto.

NOTES.

DR. J. LARMOR, secretary of the Royal Society and Fellow of St. John's College, has been elected to the Lucasian professorship of mathematics at Cambridge, in succession to the late Sir George Stokes.

AT a seismological congress held at Strasburg in April, 1901, statutes were proposed for an international seismological association. The German Government now invites delegates from various countries to meet to discuss these propositions. We learn from *Science* that this meeting will take place at Berne in May.

THE British and African Company's steamer *Bornu*, which arrived at Plymouth on February 27, experienced a heavy sand-storm on February 19, in latitude 27° north, longitude 15° 30′ west, that is, a little south of the Canary Islands. A tremendous sea prevailed for several hours, and so dense was the sand that it was impossible to see either end of the ship from the bridge.

PROF. KOCH has been elected a Foreign Associate of the Paris Academy of Sciences, in succession to the late Prof. Virchow.

WE regret to see the announcement of the death of Prof. W. Harkness, astronomical director of the U.S. Naval Observatory, and Rear-Admiral (retired) of the United States Navy.

PROF. E. MAZELLE has been appointed director of the Imperial Astronomical-Meteorological Observatory at Triest, Austria.

THE twenty-first congress of the Sanitary Institute will be held this year in Bradford, commencing on July 7. The programme of arrangements made will be given in the supplement to the April *Journal* of the Institute.

REUTER states that a telegram has been received in New York from Mr. Aymé, the United States Consul in Guadeloupe, stating that the French army engineers have established communication with Martinique by means of wireless telegraphy.

REPORTS from Mexico state that the volcano Popocatapetl has been bought up by a group of American financiers for the sum of 1,000,000*l*. The idea is to utilise the valuable deposits of sulphur contained in the volcano, to get which it will be necessary to construct a railway to the summit.

DR. J. W. GREGORY, F.R.S., professor of geology in the University of Melbourne, has met with an accident, necessitating an operation under chloroform. He was conducting scientific investigations in Tasmania at the time, and considerable anxiety has been felt concerning him. The latest news is, however, reassuring.

THE President of the Local Government Board states that the Royal Commission on Sewage Disposal is taking evidence and making investigations on the subject of dangerous contamination of shell-fish by sewage, with a view of ascertaining the measures necessary for obviating risk to the public health from this cause.

MR. W. BOWMAN writes from Kansas City, Missouri, U.S.A., with reference to the flexure of a white marble slab mentioned in NATURE of November 20, 1902 (p. 56) and November 27, 1902 (p. 81). He says that many years ago he saw at Windsor, Nova Scotia, in the churchyard of the old parish church, a marble slab bowed in the middle, exactly as described by our correspondents.

MR. HENRY PHIPPS has given Lord Curzon another 10,000*l*. for the promotion of agricultural education or scientific research in India. Colonel Lockwood has been informed by the Secretary of State for India that, in view of the great benefits conferred on the European and the native community in India by the Pasteur Institute in the Punjab, the Viceroy proposes to apply half Mr. Phipps's gift to the establishment of a similar institute in Southern India.

IN the House of Commons on Tuesday the following resolution was moved :—" That the constitution of the Board of Trade has become obsolete, and this House is of opinion that a department presided over by a Minister of Commerce and Industry, having the *status* of a principal Secretary of State, should be substituted for the present office, to which should be entrusted all matters more particularly appertaining to commerce and industry, and to that end that an

inquiry should be forthwith instituted with the view of re-arranging the duties and functions of existing departments." After discussion, both the resolution and an amendment to it were withdrawn.

Central News despatches from Mexico City report that an eruption of the Colima Volcano commenced on February 21. The disturbance continued practically incessantly until February 24, on which date, at 5.15 a.m., there occurred the most violent eruption known at Colima for many years. At 2.26 a.m. a severe earthquake shock was felt at the town of Tuxpan, near the volcano.

The Carnegie Institution has made grants to several of the professors of Johns Hopkins University to assist original researches. Prof. Harmon N. Morse has received 300*l.* for an assistant in his researches upon the new method he has evolved for measurement of osmotic pressures; Prof. R. W. Wood 200*l.* to maintain a research assistant; Dr. H. C. Jones 200*l.* for an assistant in his researches in physical chemistry; and Prof. J. J. Abel 200*l.* for the apparatus necessary to his researches in physiological chemistry.

The council of the Society of Arts, at the request of the executive committee of the International Fire Prevention Exhibition, to be held at Earl's Court during the current year, has decided to offer the following prizes at the exhibition, out of the funds of the Fothergill Trust:—One gold medal, two silver medals and two bronze medals for the best chemical fire engines for town use shown at the exhibition; and similar medals for the most easily worked long ladders, to reach the sill of a window eighty feet above the level of the pavement, which shall also be capable of being rapidly transported over roads not more than twenty-five feet wide.

The annual general meeting of the Institute of Chemistry of Great Britain and Ireland was held on March 2, when the council presented its report. The council has appointed Prof. J. Millar Thomson (the retiring president), Mr. G. T. Beilby and Dr. J. Lewkowitsch to represent the Institute at the International Congress of Applied Chemistry to be held at Berlin in June next. The council has, whenever occasion has arisen, urged upon authorities making appointments under the Sale of Food and Drugs Acts, the importance of requiring applicants to produce evidence of adequate training in theoretical and practical chemistry, and of special experience in the analysis of food and drugs.

On February 26 the Italian Minister of Marine and a number of naval experts witnessed some interesting experiments with Signor Siglio's apparatus for giving warning of the approach of submarine craft and other vessels. The Central News correspondent at Naples says that the approach of a large steamer was notified by the apparatus when the vessel was twenty kilometres distant. The approach of a small boat was signalled at a distance of twelve kilometres.

Reuter's Agency is informed that a strong and unusually well-equipped expedition is on the point of being dispatched to South Africa by the Chartered Company, for the purpose of completing up to Lake Tanganyika the scientific survey of Rhodesia. The expedition will be absent about three years, and will sail from England in time to reach Cape Town at the beginning of April. The work now in contemplation has only been rendered possible by the completion of the Cape to Cairo telegraph up to Tanganyika, which now enables the explorers to synchronise with the observatory at Cape Town. The expedition will have far-reaching results in finally determining the exact geographical position of many important centres at present imperfectly laid down upon the maps. The work is under the direct supervision of Sir David Gill, K.C.B., F.R.S., Astronomer Royal at the Cape.

With the object of bringing to public notice the economic mineral products of Ireland, the Department of Agriculture and Technical Instruction for Ireland has arranged for the Irish minerals shown at the Cork International Exhibition of 1902 to be placed on view in London. These, together with a few additions, are now to be seen at the Imperial Institute, and the exhibition remains open, admission free, for three months from February 26. The most important materials are building stones of various kinds, mainly limestones and granites; and amongst the polished marbles and granites, excellently suited for ornamental purposes, there is considerable variety. Samples of clay and sand, and of pottery and glass manufactured from the same, are shown. Coals and iron-ores are of some importance, but the metalliferous ores of lead, copper and zinc occupy only a small space. Other minerals include bauxite, gypsum, barytes, salt and diatomaceous earth; slates and paving materials are also well represented. According to the official mining statistics, the minerals annually raised in Ireland amount in value to only about 1/400th part of the total output of the United Kingdom; and it is sincerely to be hoped that this exhibition may have some effect towards developing the mineral resources of Ireland, even though these be not so extensive and varied as could be desired.

Major-General C. J. B. Riddell, C.B., F.R.S., whose death is announced at the advanced age of eighty-six, was one of the pioneers in the cultivation and extension of work in terrestrial magnetism and meteorology. Concurrently with the arrangements made in 1838-1839 for an expedition to the Antarctic regions arose the question of the desirability of extending the contemplated magnetic researches in the southern hemisphere by the establishment of fixed observatories in certain of the British colonial possessions, which should also carry on meteorological inquiries. The stations mentioned were those of St. Helena, the Cape of Good Hope and Toronto. Lieutenant Riddell was selected as director of the Canada (Toronto) branch, subject to the instructions of the Ordnance Department and Major (afterwards General) Sabine, R.A. In 1841 the reduction work for the publication of vol. i. of the Toronto observations was commenced by Sabine, who had the assistance of Riddell, and much commended the practical merits of the system inaugurated at Toronto. General Riddell was responsible for the "Magnetical Instructions for the Use of Portable Instruments Adapted for Magnetical Surveys and Portable Observatories, and for the Use of a Set of Small Instruments for a Fixed Magnetic Observatory," which was printed at the expense of the Government and issued in 1844. He outlived all his associates in magnetic observational work. At the time of his death he enjoyed the unique distinction of being the senior Fellow of the Royal Society in respect of election.

On February 25 Dr. M. W. Travers gave a lecture on the "Measurement of Low Temperatures" before the Chemical and Physical Society of University College, London. In the experimental demonstrations a thermometer was used of the constant volume type described in the *Phil. Trans.* for 1902, in which the temperature is read directly on the manometer. In the course of the lecture the bulb of the instrument was immersed in liquid hydrogen when the thermometer indicated a temperature of 20°·5 Abs. Solid hydrogen was prepared by boiling the liquid hydrogen under a pressure

of about 5 centimetres by means of a Fleuss pump. To illustrate the differences obtained in measuring the same temperature with thermometers filled with different gases, Dr. Travers concluded by giving his results for the boiling point of oxygen and hydrogen on the scale of various thermometers:—

Oxygen B.P. (He) $90°{\cdot}20$, (H) $90°{\cdot}10$, (N) $89°{\cdot}5$, (O) $89°{\cdot}0$
Hydrogen B.P. (He) $20°{\cdot}41$, (H) $20°{\cdot}22$.

These results are in agreement with Prof. Callendar's calculations based on a consideration of the physical properties of hydrogen and helium, according to which the boiling point of hydrogen on the absolute scale should be $0°{\cdot}1$ lower than the boiling point as given by a hydrogen thermometer and $0°{\cdot}1$ higher than that given by a helium thermometer.

DURING the past week the British Islands have been visited by a succession of disastrous gales from the Atlantic, accompanied by tremendous seas. The most destructive storm was that of February 27, the centre of which advanced quickly from the south-westward, and was central over Scotland on the morning of that day. The barometer fell there for nearly twelve hours at the rate of more than a tenth of an inch an hour. It was during this gale that a railway train was capsized on the Leven viaduct, near Ulverston, and the havoc to telegraph wires was so great that the Meteorological Office was unable to issue any weather forecasts. At Southport during a squall the wind reached a velocity of ninety-two miles an hour, and at Greenwich, which was more than 300 miles from the centre of the disturbance, a pressure of 33 lb. to the square foot was registered in the early morning. Other disturbances have followed very quickly from the Atlantic, and a renewal of the gales, with heavy rains, has occurred over the entire kingdom.

WE have received the German Meteorological Yearbook for 1901, issued by the Deutsche Seewarte—the twenty-fourth volume of the new series of the publication—containing daily observations and results for a large number of stations and hourly readings at four normal stations. There is considerable advantage in the German system of publication, which ensures uniformity in the meteorological volumes issued by various States. We are glad to see that the anemometrical values are expressed in terms of the revised and reduced factor, instead of that originally determined by Dr. Robinson, which assumes that the velocity of the wind moves with three times that of the anemometer cups. In an appendix Dr. H. König discusses the sunshine records obtained from various stations.

THE *Journal des Transports* reports that the Governor-General of French West Africa has recently sent out a surveying party to trace out a new railway in Senegal, between Thiès and Kayes. The line will be about 466 miles in length.

MESSRS. WORMS AND CO., writing to the *Times* of February 26, give the translation of a letter which they have received from the French Under-Secretary of State for Posts and Telegraphs, in which it is stated that a fresh Franco-English Telephonic Convention has just been signed which will permit of telephonic communication between the two countries being extended to provincial towns. The existing convention only authorises communications between Paris and London, but as soon as the new convention has received the approval of the authorities in both countries, this limitation will be removed. This extension, we do not doubt, will be cordially welcomed by the public on both sides of the Channel.

ACCORDING to the *Westminster Gazette* a conference on railway electrification is now being held, at which all the great railways are represented. The main object of the conference is to secure uniformity in electrical plant, so that the rolling stock of the various companies shall be able to travel indiscriminately over any of the lines. Such details as the distance between centre and side rails, design of motors and locomotives and so forth are being considered, and in addition many other points in relation to the electrification of steam railways. It seems that the railways are awakening to the necessity of immediate reform, especially in running their suburban lines. The object of the conference is very important, and one which we have emphasised on several occasions in these columns.

SIR OLIVER LODGE is well known to have been one of the pioneers in wireless telegraphic work, both on the theoretical and practical side; to him belongs the credit of having been the first to suggest the use of tuned systems, and he devised, and published many years ago, methods by which syntony might be practically attained. In addition to this his work on the coherer is not likely to be forgotten. We are glad to learn, therefore, that he has been engaged, in conjunction with Dr. Muirhead, in perfecting his apparatus for both transmitting and receiving, and that the system has now reached a thoroughly practical form. The Eastern Extension Telegraph Co. is experimenting with the Lodge-Muirhead apparatus on its two new cable ships, the *Restorer* and the *Patrol*.

THE daily papers last week contained announcements of three new inventions of a revolutionary character in the field of wireless telegraphy. The first relates to an invention by Mr. P. C. Hewitt, the inventor of the vapour lamp recently described in these columns, who, it is stated, has devised a method of setting up powerful and continuous oscillations in the transmitting mast; no particulars are given. The other two are of a more sensational character, and relate to the transmission of power by ether waves. Prof. Braun, it is said, has declared that he sees no further difficulty in principle, and even no serious technical obstacle to the wireless transmission of power, and Mr. T. H. Williams is credited by the *Westminster Gazette* with having worked out a wireless method of running electric motor-cars which only requires further experiment and more capital to be made commercially practicable. Until more definite particulars are published as to these systems it will be necessary to suspend judgment upon them.

NO. 159 of the *Journal* of the Institution of Electrical Engineers, which has just been issued, contains several interesting papers. These include Mr. Swinburne's presidential address, Sir Oliver Lodge's paper on electrons—which is considerably expanded from the spoken address—and Messrs. Hutton and Petavel's paper on high temperature electrochemistry; to these we have already referred in these columns. The greater part of the remaining space is filled by Prof. Fleming's paper on the photometry of electric lamps and the discussion to which it gave rise. Prof. Fleming, in this paper, describes a new form of standard incandescent lamp made by enclosing an "aged" filament in a large bulb, which he states answers very well as a working standard. The paper also deals with some of the many problems which photometry presents, and with the discussion, in which Mr. Harcourt, Dr. Glazebrook, Sir W. Abney, Mr. Trotter, Prof. Ayrton, M. Violle and Mr. J. Petavel took part amongst others, forms a most valuable contribution to the subject from both the theoretical and practical sides.

THE Meteorological Office pilot chart for March directs attention to the unusually cold water observed at various times during last December in mid-ocean, on the Transatlantic steamer routes, surface temperatures as low as 38° to 45° being recorded where the normal values are from 50° to 53°. On the western coasts of the British Isles, also, for about a week from December 5, when an easterly type of weather prevailed, the shore water was very cold, 36° to 38° being recorded even up the west of Ireland, and at Newquay, on the Cornish coast, the minimum was 41°. The general range of water temperature during the month was from 10° to 14° at the western stations, against from 4° to 7° at the east coast ones. At the beginning of February the first ice of the season was drifting down the east coast of Newfoundland and blocking the harbour of St. John's.

A LENGTHY article on "White Water" in the March pilot chart of the Meteorological Office gives many interesting particulars relating to the phenomenon known to seamen as the milky sea, which seems to be more frequently observed in the tropical waters of the Indian Ocean than elsewhere. Various observers describe the scene as "ghastly," "awe-inspiring," "wild, weird and rather ancient marinerish," &c., and Captain Carpenter, of the *Challenger*, states that when in the milky sea a ship seems to be passing through a sort of luminous fog in which all sense of distance is lost; sea and sky seem to join, and there is almost as much danger of collision as in a true fog. Although the phenomenon is doubtless a form of phosphorescence, no adequate explanation of it has yet been arrived at.

A REPORT on the fishes collected in the expedition of 1898 to Socotra and southern Arabia has been communicated to the Vienna Academy by Herr F. Steindachner. In addition to several rare species hitherto only known from the Atlantic Ocean, the collections contained six new forms.

No. 80 of the *Communications* from the Leyden Physical Laboratory contains an account of Dr. L. H. Siertsema's measurements of the magnetic rotation of the plane of polarisation of liquefied chloride under atmospheric pressure. For sodium light the value found is 0'·01372, and the rotation dispersion is normal, differing little from that with gases and with water.

UNDER the title "The Practice Curve," Mr. J. H. Bair, in a special supplement of the *Psychological Review*, describes experiments for investigating various aspects of association, such as the relation between the sensory and motor side of our mental life, the processes involved in the formation and modification of habit, and endeavours in general to find a satisfactory physiological and psychological explanation for the phenomena of association.

A PAPER on the protective action of wire gauze against explosions has been communicated to the Vienna Academy of Sciences by Dr. H. Mache. The author considers the case where a homogeneous gas-mixture traverses the gauze with a velocity less than the rate of propagation of an explosion. In this case the flame approaches the gauze, but comes to a standstill in front of it. This effect is attributed to the absorption of part of the heat of combustion by the wires, whereby the rate of propagation of the explosion is decreased. By means of certain assumptions, the author investigates a formula for the distance at which the flame stops short of the gauze.

A USEFUL glossary of the minerals and mineral localities of Texas has been prepared by Dr. F. W. Simonds (*Bulletin* No. 5 of the University of Texas Mineral Survey). Such substances as lignite, pearls, pottery clay and petroleum are included.

IN the *Proceedings* of the Cotteswold Club (vol. xiv. part ii., 1903) there is a detailed account of the Rhætic strata in north-west Gloucestershire, by Mr. L. Richardson, who adds many new particulars relating to well-known sections, and describes some fresh localities. There is also the address of the president, Mr. E. B. Wethered, who discusses the origin of certain Palæozoic sandstones and limestones.

PROF. W. W. WATTS contributes an excellent account of the older rocks of Charnwood Forest, with a map showing the structure of the ground if the Trias and more recent deposits were stripped off (*Proceedings* of the Geologists' Association, vol. xvii., parts vii. and viii.). The structure is that of an anticline traversed by thrust-planes and drop faults. Attention is also directed to the terraced and smoothed surfaces of the granite under Keuper Marl at Mountsorrel. These features are attributed to wind erosion in Triassic times, and they are well depicted in a photographic plate.

"THE Greatest Flying Creature" is the title of an essay by Prof. S. P. Langley, and it is introductory to a paper on the pterodactyl *Ornithostoma ingens* by Mr. F. A. Lucas (Smithsonian Report for 1901, 1902). The questions discussed are:—"What has Nature herself done in the way of large flying machines, and are the birds which we see now the limit of her ability to construct them?" Prof. Langley gives particulars relating to various insects and birds, of the wing surface and its relation to the weight of the creature; and these show that the larger the insect or bird, the smaller is the relative supporting surface. He adds, "The explanation may be very near at hand, but it is not to me evident."

SIGNOR LUIGI BRUGNATELLI describes (*Rendiconti di Reale Istituto Lombardo di Sc. e. Lett.*, 2, xxxv. p. 869) a new mineral, "artinite," from the Valle Lanterna, which is interesting chemically as a basic hydrated magnesium carbonate not before known, and interesting petrologically as a final decomposition product of a peridotite rock. Its chemical formula is $MgCO_3.Mg(OH)_2.3H_2O$. Its hardness is about 2·5, its specific gravity about 2·02, and its mean refractive index about 1·53. It is biaxial and optically negative, but its crystallographic system could not be determined with certainty. It is probably monoclinic.

THE Cambridge University Press has published solutions of the examples in the "Elements of Hydrostatics," by Mr. S. L. Loney, who has prepared this "Key" to his book.

A SELECTION of Dr. G. Stanley Hall's papers on the psychology of children and its relation to pedagogics has been translated into German by Dr. J. Stimpfl, and published by Herr O. Bonde, Altenburg, under the title "Ausgewählte Beiträge zur Kinderpsychologie und Pädagogik." Dr. Stimpfl contributes an introduction, in which he gives an appreciative account of Dr. Hall's valuable studies of child psychology.

THE first volume of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," edited by Mr. J. Stanley Gardiner, has been completed by the issue of the fourth part from the Cambridge University Press. This part contains papers on the Cephalochorda collected by the expedition of 1899 and 1900, the birds, earthworks, the Maldive and Laccadive groups, with notes on other coral

formations in the Indian Ocean, marine crustaceans and the Lithothamnia. The first part of the second volume will be published next June.

AN index, prepared by Mr. Clement Reid, F.R.S., for De la Beche's "Report on the Geology of Cornwall, Devon and West Somerset," has recently been published for the Geological Survey, and can be obtained from any agent for the sale of Ordnance Survey maps. The Report was published in 1839, unfortunately without an index. No less than 1500 copies were issued, and the memoir is now out of print. It has, however, become one of the classics of geology, and being a permanent work of reference, an index has been a great desideratum, which has now been supplied.

MESSRS. JOHN J. GRIFFIN AND SONS, LTD., have sent for our inspection a simple mechanical device for obtaining rapidly any required set of numbers having the same ratio among themselves as any other given set of numbers. The instrument is known as the "ratiometer," and was designed by Mr. A. E. Munby. It is made of boxwood, and consists of two graduated rules, which can be set at any angle, which with one edge of a T-square form a right-angled triangle. By means of a tongue and groove the base of the triangle slides along the stock of the T-square. The ratiometer should prove of great assistance to examiners for the reduction of marks. It would be useful in laboratories, where it could be used for such operations as the conversion of centimetres to inches, or of scales of temperature, and in the office and workshop for converting one linear scale into another when no simple ratio exists between the two, or for finding the value of various quantities of goods.

THE international committee on atomic weights, organised in 1900, and composed of more than fifty representatives from chemical and other societies, has by vote designated a smaller body of three representatives to carry on the future work of the committee. The three elected members, Profs. Clarke, Thorpe and Seubert, have just issued their annual report and recommendations. It is pointed out that upon the question as to whether oxygen or hydrogen shall be taken as basis of the atomic weight numbers, opinion at the present time seems to be evenly divided. To force the adoption of either appears to be impossible, and experience must be the final arbiter. That standard which best serves to coordinate chemical and physical knowledge will ultimately be chosen, and the other will gradually fall into disuse. Tables are appended to the report in which both standards of atomic weights are represented. In view of recent work, the committee has thought it necessary to make changes and recommendations in respect to the atomic weights of antimony, germanium, hydrogen, lanthanum, mercury, palladium, selenium, tin, uranium and zirconium. Radium appears for the first time in the table with an atomic weight = 225.

UP to the present time very few instances of chemical changes which exhibit periodicity have been observed. Very recently it was found by Ostwald that the velocity of solution of certain samples of chromium in acids does not change in a continuous manner as would be theoretically anticipated, but that the rate of solution increases and decreases periodically. An apparently similar change has been found by Bredig and Weinmayr in the catalytic decomposition of hydrogen peroxide by means of metallic mercury. An account of the authors' experiments is given in the current number of the *Zeitschrift fur physikalische Chemie*. In successive intervals of time the amounts of hydrogen peroxide are alternately larger and smaller, and the alternation appears to be simultaneous with a change in the character of the mercury surface. Preliminary experiments indicate that the alternations of the catalytic activity of the mercury are intimately connected with alternations in its electrical condition. In the inactive condition the mercury is considerably more electro-positive than in the active condition.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH :—

March 10. 4h. 59m. to 5h. 50m. Moon occults α Cancri (mag. 4·3).
14. 11h. 40m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·904, of Mars = 0 991.
15. Venus. Apparent diameter = 11″·2, Mars = 13″ 8.
17. 8h. 29m. Minimum of Algol (β Persei).
18. 16h. 1m. to 17h. 25m. Moon occults χ Ophiuchi (mag. 5·0).
21. 7h. Sun enters Aries, Spring quarter commences.
25. Perihelion Passage of Giacobini's comet (D 1900).
28. 14h. 5m. Annular eclipse of the sun, invisible at Greenwich.
28. 20h. Mars in opposition to the sun.
30. 20h. Venus in conjunction with the moon. Venus 2 13′ N.

COMET 1903 *a*.—M. Paul Brück, of the Besançon Observatory, publishes an ephemeris for this comet, from which the following is an abstract, in No. 3847 of the *Astronomische Nachrichten*.

Paris 12h. M.T.

Date.	α app. h. m. s.	δ app. ° ′	log r.	log. Δ	Brightness.
Mar. 6	0 13 52	+17 27·9			
,, 8	0 18 26	+18 3·9	9·6919	0·0141	18·1
,, 10	0 22 57	+18 31·8			
,, 12	0 27 18	+18 48·1		9·9602	
,, 14	0 31 22	+18 48·5			
,, 16	0 35 3	+18 27·9	9·6251	9·9010	41·3

From an observation by M. Chofardet on February 13, a correction of $\Delta\alpha = -4s.$, $\Delta\delta = -0'·2$ to this ephemeris was obtained, and the magnitude was recorded as about 9·0.

The comet was observed at Lyons by MM. G. le Cadet and J. Guillaume on various dates between January 21 and 29, and they record it as "a faint nebulosity without elongation and without tail."

A new set of elements, published in the same journal by M. G. Fayet, gives the time of perihelion passage as March 18·7092 M.T. Paris.

COMET 1902 *b* (PERRINE).—An ephemeris for this comet is published in No. 3847 of the *Astronomische Nachrichten*, by Herr Ebell, as a continuation of that which appeared in No. 3841 of the same journal. It indicates that the comet is rapidly becoming fainter, and an observation made at Strasburg on February 17 showed that, on that date, the magnitude was only about 11·5.

HERSCHEL'S NEBULOUS REGIONS OF THE HEAVENS.—Commenting on Dr. Isaac Roberts's recently published results, which indicated that only four of the fifty-two nebulous regions described by Herschel in 1811 really contained nebulosities, Prof. E. E. Barnard remarks that this question is likely to prove an important factor in future discussions as to the physical condition of the universe, and then proceeds to explain that the negative results obtained by Dr. Roberts may be due to insufficient exposure, and that it is highly improbable that Herschel should have been so palpably mistaken in forty-eight cases out of his fifty-two regions.

In support of his argument Prof. Barnard proceeds to describe several photographs, which he has obtained with a 1·5-inch magic lantern lens of 4·9 inches equivalent focus, which suggest that in one or two cases at least Dr. Roberts's conclusions require further consideration.

One striking instance is illustrated by a reproduction showing a great curved nebulosity which embraces the

greater part of the constellation Orion, and of which the brightest part corresponds, in position, with Herschel's region No. 27. Of this region Dr. Roberts remarked "sky clear, stars very few in number, large areas void of stars, no nebulosity," yet the photograph shows a distinct nebulosity in this region, and photographs obtained by two independent observers, with three different photographic telescopes, on several different occasions, confirm Herschel's observations.

Both Dr. Roberts's results and Prof. Barnard's comments thereon appear in No. 1, vol. xvii. of the *Astrophysical Journal*.

A NEW STAR CATALOGUE.—Volume viii. of the *Annalen* of the Leyden Observatory, edited by Dr. H. G. van de Sande Bakhuyzen, is a new catalogue of 10,239 stars situated in the zone 29° 50′ to 35° 10′ north latitude, and having magnitudes of 9·5 or brighter.

The observations have been made and reduced at Leyden, in accordance with the programme of the Astronomischen Gesellschaft, during the years 1870-1876 and 1880-1898, by Messrs. W. Valentiner, E. F. van de Sande Bakhuyzen, E. Becker, J. H. Wilterdink and H. G. van de Sande Bakhuyzen, and the observations of the former period have been already published in vols. iv. and v. of the *Annalen*.

The catalogue gives the position for 1875, the magnitude, the precessional and secular variation in each coordinate, the epoch and the B.D. number (where there is one) for each star, and, in additional tables, these positions are compared with those given in the Bessel, Argelander, Struve and other catalogues for the same objects.

RECENT SCIENCE IN AUSTRIA.

Chemistry.

A PERUSAL of the *Sitzungsberichte* of the Vienna Academy of Sciences indicates that a great deal of valuable chemical research work is being carried out by Austrian investigators. In the concluding section of vol. cx., J. Klimont gives an account of experiments on the composition of oleum cacao which indicate that this substance can no longer be regarded as a mixture of tristearin, tripalmitin and triolein, but that it is essentially a mixed glyceride containing the radicles of these three acids united to one and the same glycerin radicle. Other mixed glycerides containing oleic acid and fatty acids of smaller molecular weight are also present in the fat.

The action of acetylene as kathodic depolarising agent in the electrolysis of acid and alkaline solutions has been investigated by Dr. Billitzer, who finds that this substance readily acts as depolariser with a kathode of platinum, and that the products of its action are ethylene and ethane. Within certain limits of potential, it is possible to obtain a quantitative yield of ethylene. If the potential is gradually increased, mixtures of ethylene and ethane are produced at the kathode, and later hydrogen also makes its appearance. In sulphuric acid solution and with a mercury kathode, small quantities of alcohol are also formed from the acetylene.

The nature of that physiologically most important substance, chitin, has been further investigated by Drs. Fränkel and Kelly. The view advanced by Schmiedeberg that chitin is an α-acetyl-acetoacetic acid compound of chitosamine of the formula $C_{18}H_{30}N_2O_{12}$ can no longer be regarded as correct in the light of this more recent work. This conception of the nature of chitin was largely based on the production of chitosamine and acetic acid by boiling with strong hydrochloric acid, but the authors' experiments indicate that its constitution cannot possibly be of such a simple character.

In vol. cxi., Dr. von Cordier describes a peculiar reaction exhibited by iron and steel. If iron containing carbon and nitrogen is treated with dilute acid and excess of ammonia added to the solution, a distinct odour of carbamine is observable. The author's experiments indicate that the reaction is only obtained if both these elements are contained in the same sample of iron. A mixture of two samples, one containing carbon but no nitrogen, the other nitrogen but no carbon, does not evolve any isonitrile. Investigation of the small quantity of gas given off shows that it is ethylcarbamine.

In a series of papers, Prof. Wegscheider discusses the question of the influence of constitution on the affinity constants of organic acids and gives the results of his experiments on the partial esterification of unsymmetrical di- and poly-basic acids. Special attention is devoted to the alteration produced in the affinity constant by the substitution of hydrogen by ester groups such as SO_3CH_3, CO_2CH_3, $CO_2C_2H_5$ and by the carboxyl group. A considerable addition to our knowledge of this subject results from these investigations. The data obtained are utilised by the author to determine the configuration of the ester acids obtained by partial esterification of unsymmetrical polybasic acids.

Two other papers by Dr. Billitzer treat of the acid character of acetylene and the formation of carbon ions in aqueous solution. In the first of these, the solubility of acetylene in solutions of the alkalis has been studied. By suitable elimination of the physical action of the dissolved bases, it is shown that acetylene undoubtedly forms salts in the alkaline solutions and that it must be regarded as a very weak acid, its dissociation being about 1/4000th of that of carbonic acid. In the second paper, the presence of carbon ions in solutions of silver and copper acetylides is shown by electromotive measurements, and by electrolysis of these solutions under suitable conditions a small deposit of carbon has been obtained on the anode. By two independent methods, the electrolytic dissociation of acetylene has thus been demonstrated.

Physics.

In mathematics, attention should be directed to F. Mertenz's proof of Galois' fundamental theorem of the groups of an equation the coefficients of which belong to a given range of rationality. A construction for the six normals from any point to a conicoid, based on the methods of synthetic geometry alone, is given by Prof. August Adler.

In theoretical physics, perhaps the most extended mathematical investigations are those by Dr. Josef Grünwald dealing with the propagation of waves in uniaxal crystals when the initial disturbances are given. Dr. Grünwald finds for the vector potential a series of waves partly "ordinary," partly "extraordinary" and partly "intermediate" in character. A formula is discussed by G. Jaumann for the heat generated in the motion of a viscous liquid. The expression involves volume integrals of the squares of the curl, and divergence and a surface integral; in the case of an incompressible liquid, this result agrees with the known formulæ in which the only volume integral is that involving the square of the curl. The difficult subject of astronomical aberration and its relation to the ether is discussed by Dr. Egon v. Oppolzer, and in molecular physics, Prof. O. Tumlirz's paper on the "cohesion pressure" terms in Van der Waals's equation, H. Mache's discussion of the relative magnitudes of molecules in a liquid and its vapour, and Dr. G. Jäger's investigation of the law of partition of energy between the liquid and the vapour may be noticed.

In spectroscopy, Dr. Edward Haschek has been working at the relation between wave-length and quantitative composition, and while the conclusions are on the whole remarkably consistent, it appears that at present the method is unsuited generally for laboratory analysis. In collaboration with Prof. Exner, Dr. Haschek has drawn up a list of the spectral lines of europium, including 1193 spark and 527 arc lines. The element europium has also had its magnetic properties compared with gadolinium and samarium by Dr. Stefan Meyer, the preparations of Eu_2O_3 having been obtained from Demarçay.

The diathermanosity of water and certain solutions forms the subject of a paper by Otto Dechant, who finds that as the temperature increases the transparency for heat decreases according to a formula approximately linear. Alum solution is only 2 per cent. less diathermanous than water, but cobalt chloride is better, and its coefficient decreases more rapidly after 50° than between 11° and 50°.

That the freezing points of aqueous solutions are lowered by pressure to a greater extent than that of water is the conclusion of A. Lampa.

In terrestrial physics, a long series of tables relating to rainfall and *inter alia* its supposed connection with sun-spots is drawn up by J. Hann, and Prof. B. W. Stankewitsch describes magnetic measurements made with a "magnetic theodolite" in Pamir during his travels in 1900.

The series of papers on atmospheric electricity includes a comparison of brush electrodes and flame electrodes by Dr. Victor Conrad and a description of a self-registering atmospheric electrometer by Dr. Hans Bensdorf.

Electric discharges form the subject of papers by J. Nabl, in

connection with the gases at the electrodes of the Wehnelt interrupter, and by Dr. Ernest Lecher, in connection with the effect of electrification of the field on the discharge. The electric conductivity of powders is treated by Franz Streinitz.

Speaking generally, the physical papers show a considerable amount of steady, plodding work in the elaboration of existing theories and the tabulation of statistical results rather than any very striking innovations in the direction of new theories.

Zoology.

The systematic position of the armoured dinosaurs from the upper Cretaceous of the Gosau district, originally described, on the evidence of extremely imperfect material, under the names of Struthiosaurus, Cratæomus and Anoplosaurus, has recently occupied the attention of Herr F. B. Nopessa, jun. (*Sitzungsberichte*, vol. cxi. p. 93, 1902). The author follows some previous observers in regarding the first and second of these presumed generic types as identical, as also in considering the third to be inseparable from the Huxleyan Acanthopholis. Consequently, the two genera Struthiosaurus and Acanthopholis have alone to be considered.

The suggestion of the late Prof. Marsh that these European forms are members of the same family (Ceratopsidæ) as the horned dinosaurs of the topmost Cretaceous of North America is discountenanced by Herr Nopessa. Rather, he thinks, they typify a family by themselves—the Acanthopholididæ—in many respects intermediate between the comparatively generalised Stegosauridæ and the highly specialised Ceratopsidæ. From the horned dinosaurs, the members of the intermediate family are readily distinguished by the absence of bony horn-cores on the skull and also of a frill-like neck-shield. They are further characterised by the non-fusion of the cervical vertebræ, the relatively large fore-limbs and the long and powerful tail. As regards the large size of the fore-limb, they are connected with the Stegosauridæ by the Wealden Polacanthus. Taken as a whole, their organisation tends to confirm the view that among the armoured dinosaurs the early bipedal, or partially bipedal, forms are the more primitive, and the quadrupedal types (Ceratopsidæ) the more specialised.

In the same communication, Herr Nopessa describes a chambered vertebra of one of the gigantic sauropodous dinosaurs from the Cretaceous of Neuquen, Patagonia. The reptile to which this vertebra belonged is regarded as generically distinct from Titanosaurus and Argyrosaurus, both of which have been recorded by Mr. Lydekker from the formation in question, but no further attempt is made to determine its systematic position. The sauropodous dinosaurs are now known in the southern hemisphere from both Madagascar and Patagonia.

Mollusca, both recent and fossil, have come in for a considerable share of attention in the issues of the *Sitzungsberichte* recently to hand. In vol. cx. p. 315, Herr R. Hoernes describes new cerithia, belonging to the group typified by *Clava bidentata*, from the Tertiary of Oisnitz, in Central Styria, with remarks on the distribution of that group in the Mediterranean and Sarmatian horizons. The paper is illustrated by a beautifully executed plate. In the succeeding volume (p. 5), Dr. C. Gorjanović-Kramberger treats of the Tertiary cockles of the genus Limnocardium in Croatia, more especially those pertaining to the subgenus Budmania. Some doubt has been thrown on the right of the latter group to distinction, but, from the hinge and other characters, the author justifies its separation from the more typical form. Finally, in the same volume (p. 123), Dr. R. Sturany discusses our present knowledge of the land molluscs of Asia Minor, describing a few new forms.

Botany.

An interesting paper by Prof. Haberlandt gives an account of cultural experiments made with isolated plant cells. These were taken from the mesophyll tissue of the leaf of *Lamium purpureum*, and when placed in culture solutions were kept living for several weeks. Considerable increase in size was observed in some cases, and an appreciable increase in the thickness of the walls occurred, especially where the walls were concave. In the solutions containing only inorganic salts, the chlorophyll corpuscles soon turned yellowish, but kept their green colour when sugar was supplied. It would appear that the plastids pass on all the products of their assimilation and require to be constantly nourished, to prevent decomposition of the chlorophyll. With regard to the renewed growth of the cells when isolated, Prof. Haberlandt regards this as the continuation of growth which is ordinarily arrested in the leaf to suit the requirements of the organism. Two peculiar effects of light are described by Dr. H. Molisch. A flagellate, *Chromophyton Rosanoffii*, shows a large chromatophore which takes up a position on the shaded side. If viewed from the direction in which light rays are impinging upon the organism, at certain angles the cells seem to sparkle. The effect is due to the light which is condensed by the cell on the chromatophore and thence reflected, and is similar to that described for the moss Schistostega. The second paper refers to the light which is emitted by the bacterium *Micrococcus phosphoreus* obtained during the decomposition o meat. The light is sufficiently strong to produce heliotropic curvature in many seedlings, and also in the sporangiophores of Phycomyces.

The poisonous effects so well known in the case of leaves of *Primula obconica* are further elucidated by the investigations of Dr. A. Nestler. Besides various cultivated forms of *Primula obconica*, three species, *Primula sinensis*, *Primula Sieboldii* and *Primula cortusoides*, all belonging to the group *sinensis*, were found to produce similar effects, giving rise to throbbing and inflammation. The source of irritation was traced to the secretions of glandular hairs. These readily crystallise out, and by sublimation were obtained pure. The writer recommends the outward application of strong alcohol as a palliative.

THE FUTURE OF COAL GAS.[1]

WHEN, in the early years of last century, coal gas became a commercial reality, the one end and aim of the manufacturer was to produce his gas, and such details as purity, illuminating and calorific value never troubled his mind. As time passed on, however, and competing companies vied with each other in their endeavours to secure customers, advantages had to be offered to coax consumers from the enemy's camp, and those who remember the battle of the two then existing City companies with another proposed rival in 1847–48–49, and the way in which the gas consumers in the City were at that time pestered and pamphleted by the supporters of the rival schemes, will realise that even in those days gas management was not a bed of roses. The outcome of the rivalry was the introduction in the early 'fifties of a standard of illuminating value, and a string of Parliamentary requirements which have ever since safeguarded the consumer and harried the gas manufacturer.

In 1850 a Bill was passed which enacted that a consumption of 5 cubic feet of gas per hour should be equal to the light of twelve wax candles of the size known as sixes, the burner employed being a brass Argand burner with fifteen holes. In 1860 another Act changed the illuminating power to twelve sperm candles, which meant an increase of some $16\frac{1}{2}$ per cent. in the illuminating value of the gas, owing to the fact that the wax candles originally used were only equal in illuminating power to 10.3 sperm candles, as at present employed for testing purposes. In 1868 the illuminating power was again raised to fourteen candles, whilst, in 1876, the present sixteen-candle standard was reached.

The amount of light emitted, however, by the gas was still insufficient to satisfy the desires of the consumers, who, utterly ignoring the fact that the illumination to be derived from coal gas was quite as much dependent on the burners employed as it was upon the standard illuminating value, vented their dissatisfaction at the light emitted by small flat-flame burners by clamouring for a higher quality of gas; and even thirty years ago the great aim of the gas-consuming public was to obtain the highest candle power that could be squeezed out of the gas company, in order that they might gain something like decent illumination from the flat-flame burners then almost exclusively used, and which were, as a rule, so small as to destroy entirely the value of the gas. It was at this period that the anomaly became common of seeing a town supplied with gas of more than twenty-candle illuminating value swathed in semi-darkness, whilst another, using the much-abused thirteen- or fourteen-candle gas, supplied at a good pressure and burnt in decent-sized burners, was well illuminated.

It was at this time, also, that some of our most able chemists ranged themselves on the side of the votaries of

[1] Abstract of Cantor lectures delivered at the Society of Arts by Prof. V. B. Lewes.

high illuminating power, and even such practically minded men as the late Sir Edward Frankland clamoured for the introduction of high illuminating power gas, such as is produced from cannel, in place of sixteen-candle coal gas, the general line of argument being well shown by portions of Sir Edward Frankland's introduction to the section of his published researches dealing with applied chemistry, in which such paragraphs as the following occur :—

"Coal gas is not suitable for use in dwelling houses by reason of its very low illuminating power—100 cubic feet of coal gas containing only 4 cubic feet of illuminating gas; the rest is mere rubbish, which heats and pollutes the air in which the gas is consumed. . . . It cannot be too widely known that coal gas, although it costs less per 1000 cubic feet, is, light for light, much dearer than cannel gas." [1]

Even now, when altered circumstances make a high-power gas an anything but desirable and economical supply, there are not wanting advocates who, undaunted, or perhaps ignorant of the practical side of the question, still try to bolster up the old idea.

It was in the latter part of the 'eighties that the lot of the worried manager was made even harder by the rise in price taking place in cannel coal, on which, up to that time, he had entirely relied in admixture with ordinary gas coal to give those higher grades of illumination demanded by the fashion of the time, and which, although it ruined his coke, yet proved an efficient and trustworthy servant.

This increase in price became so serious that in 1889 the Gas Light and Coke Company commenced experiments which led to the introduction of carburetted water gas in place of cannel as an enricher, this process proving itself a most valuable addition to the manufacture of coal gas, and rapidly gaining favour and popularity, not only as giving an easy means of raising the candle power of poor coal gas, but also as a stand-by in case of any sudden calls upon the production power of the works.

About this same period also, another method of enrichment was introduced, which consisted of adding to gas which did not fulfil the Parliamentary requirements the vapours of such highly volatile hydrocarbons as petroleum spirit and benzol, which, on account of their high illuminating value, gave the necessary increase in the candle power by the addition of an amount of vapour not likely afterwards to recondense from the gas.

Whilst these changes were taking place in gas manufacture, rivals which seemed to threaten its very existence had forced their way to the front, and with the electric light largely used by the rich, and petroleum reduced to a price at which even the poorest could afford its use as an illuminant, the field of utility seemed to be rapidly disappearing from beneath the feet of the gas industry. However, when things were looking their blackest, there slowly struggled into prominence and commercial success a factor which at once restored gas to its position of primary importance.

It was in 1885 that the researches of Dr. Auer von Welsbach culminated in the production of the incandescent mantle, which, frail and unsatisfactory in its earlier forms, was gradually so improved in composition and manufacture that by 1892 it became a brilliant commercial success, and placed in the hands of the gas industry a weapon which rendered its position unassailable in competition with electricity.

Looked at from a common-sense point of view, the incandescent mantle will be seen to be merely a method of enrichment. Instead of increasing the illuminating power of a flame by crowding into the gas more and more hydrocarbons, which during combustion are capable of separating carbon particles, the incandescence of which would increase the amount of light emitted by the flame, and *pro rata* the amount of heating and vitiation, with the mantle you charge the flame with incombustible particles of far greater light emissivity than the carbon possesses, and they do their work without that increase in the temperature and fouling of the atmosphere inseparable from the other processes. It is the introduction of the incandescent mantle and the improvements which are possible in its construction which really give the possibilities to the gas of the future.

Taking the enriched gas as supplied during the 'nineties, the light which can be obtained from it is entirely dependent upon the burner in which it is consumed. This may be stated as follows :—

Light emitted per cubic foot of sixteen-candle gas consumed.

Burner.	Candle units.
Incandescent—high pressure	30 to 35
,, Kern	20 to 25
,, ordinary	14 to 19
Regenerative	7 to 10
Standard Argand	3·20
Ordinary Argand	2·90
Union jet flat flame No. 7	2·44
,, 6	2·15
,, 5	1·87
,, 4	1·74
,, 3	1·63
,, 2	1·22
,, 1	0·85
,, 0	0·59

In considering the value given to the gas by these burners, it is seen that, according to the method by which it is burnt, the consumer may obtain anything from thirty-five candles down to less than one candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good, well-made burners, giving the best duty that can be obtained from them, whilst an examination of burners used in consumers' houses shows that in most cases any antiquated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are those who most disregard the method of its consumption.

England is far behind Germany in the use of incandescent lighting, and an inquiry made into the uses to which the coal gas supply of a large town was put gave the following result :—

	Per cent.
Incandescent lighting—private...	12·00
,, public	6·25
Cooking	22·65
Gas engines	6·60
Used in other ways	52·50
	100·00

So that 47.5 per cent. is used for purposes in which illuminating power is of no use and calorific effect is the one important factor.

It is also seen that 18.25 per cent. of the total gas made is used for incandescent lighting, and this represents about 23 per cent. of the gas used for illuminating purposes, as against 90 per cent. used in this way in Germany.

This 23 per cent. thus used gives for a consumption of five cubic feet not less than seventy candles, whilst the average light obtained by the combustion of the remaining 77 per cent. is 8.5 candles.

It is quite clear that under such conditions as these the supply of gas of a high candle power is simply waste of money, and it is manifestly unfair that the consumer of average intelligence, who is willing to utilise the benefits given by the incandescent mantle, should have to pay for a quality of gas only rendered necessary by the inertia of those who decline to march with the times.

Coal gas is daily being used more and more as a fuel, and although the slight diminution of calorific value which must of necessity accompany a lowered illuminating value is a slight drawback, yet in practice any desired temperature can be attained by a slightly larger consumption. Also a cheapening of the gas would induce many to adopt it as a fuel, this in turn tending to level up the load in production, and so to render more economies possible.

Everything clearly points in one direction, and that is, that the future of coal gas is entirely dependent upon a plentiful supply of low-grade gas—low grade from the point of view that it should only have an illuminating value of ten to twelve candles, that its heating value shall be as high as can be practically attained and that its price shall be as low as is consistent with the interests of the consumers as well as of the shareholders in the gas industry.

Already the stream has set in in this direction, and the

[1] Frankland's "Experimental Researches in Pure, Applied and Physical Chemistry," 1877, p. 488.

lowering of the Parliamentary standard of sixteen to fourteen candle power in the case of the South Metropolitan, Commercial and West Ham Companies will soon be followed by many companies now saddled with a higher standard than fourteen candles seeking relief. That relief cannot in fairness be refused, whilst experience of the benefits conferred by the reduction will soon lead to the further step that will place gas manufacture in this country on the same advanced footing that it has already gained in the most progressive cities in Germany.

In making low-grade gas of this character, several processes may be employed, but probably the most economical is to utilise water gas as an aid to the distillation of the coal in the retorts, the proportion of water gas so used being kept down to a point at which the carbon monoxide in the finished gas shall not exceed 16 per cent.

The cheapening in mantles which is now taking place, together with improvements in their manufacture which will give an increased length of life and light, promises a great extension in the use of gas for this purpose.

Another direction in which the future of coal gas will benefit largely, by a cheapening in price owing to economies in manufacture and distribution, will be for use as a fuel. Already the ever-increasing demand made upon the metropolitan companies during the day marks the advance of the utilisation of coal gas for cooking, heating and power, so that whilst the increase in the amount of gas used at night is only rising by some 3 per cent. annually, the day consumption shows an increase of 16 per cent. Directly it becomes possible to reduce the price of gas to about 2*s.* a thousand, advance on these lines will become extremely rapid, and the gas companies are naturally doing everything in their power to foster this development. It is, however, necessary, in order further to popularise gas as a fuel, that everything that can be done should be done to remove any prejudices that exist against heating by gas.

There are many excellent gas stoves on the market, well designed, and giving high heating duty for the gas consumed, but there are also many that, both in their performance and their effect upon the atmosphere, are radically bad. Now that the gas companies have so largely taken over the sale and pushing of gas-heating apparatus, it is a duty they owe to themselves and to their customers to take care that only stoves of scientific construction and good efficiency should be supplied. Many of the worst stoves are the most ornate, and for that reason find their way into many homes, as they, in the first place, appeal to the eye of the housewife, and afterwards to the nose and health of the household, the result being that a good customer is converted into an enemy of gaseous fuel. No gas fires should be sold or let on hire that do not do a large proportion of the heating by radiation, and a gas company that sells a flueless gas stove, save for hall or passage heating, should be prosecuted.

A cubic foot of coal gas on its complete combustion yields 0.52 cubic foot of carbon dioxide and 1.30 cubic feet of water vapour, and if you do not mind breathing hot polluted air highly charged with water vapour, and getting chilled with cold walls, a Bunsen burner stood on the floor is the most effective method of getting the whole of the heat of combustion into the air of the room, and no flueless stove can do more than this. In order to get something to sell, stoves are constructed in which some of the water is condensed, and the public are gravely informed that this removes all deleterious products. But it is impossible to get away from the fact that if healthful heating is to be obtained, it is the solid objects and walls of the room that must be heated, and not the air, and that although some of the heat is lost thereby, a flue to take off all products is an absolute essential.

The gas companies have it in their power to govern the gas-stove trade, and unless they choose to take the initiative, it will retard the popularity of heating by gas to a most serious degree. With all stoves in which solid bodies like asbestos are heated by atmospheric burners, a trace of carbon monoxide is always produced, and if there is not a proper flue passing well into the chimney, a headache is added to the other discomforts.

Improvements in gas motors and gas engines are steadily going on, and as soon as the price of coal gas can be reduced sufficiently to attract this class of custom, a wide field will be opened up for it.

The development of large gas engines during the last few years gives promise of an entire revolution in our methods of procuring power, and it is highly probable that within a very few years the gas engine will make great inroads upon the generation of power by steam. Already gas engines up to 1500 horse-power have been constructed, whilst engines of more than double that power are under construction.

In England, Messrs. Crossley Brothers and other well-known makers are producing a very large number of such engines for driving dynamos, whilst it is stated that on the Continent Messrs. Korting Brothers have made, or have under construction, thirty-two gas engines, with a total of 44,500 horse-power, averaging 1390 horse-power each engine, and the John Cockerill Company and several German companies follow not far behind.

With such a development of gas for motor purposes, it is manifestly the policy of the gas companies to make a determined bid for so wide a field of output, and if they can supply a clean heating gas with 460 to 500 B.T.U.'s heating power, it is clear that the convenience of doing away with separate generating plant would cause a large proportion of this business to fall to their share, if the price of the coal gas could be made to compete with a fuel gas, that is to say, if nearly the same number of thermal units could be obtained by its use at the same cost.

Gas fittings should be entirely taken over by the gas companies, which should supply incandescent fittings and mantles and keep them in order at a small yearly rental; and where swinging brackets and other causes demand flat-flame burners, the companies should fit nipples with broad slits regulated to burn at the lowest possible pressure.

Everything at the present time points to the gas of the future being a twelve-candle-power gas, with a calorific value of not less than 460 B.T.U.'s net and a selling price of not more than 2*s.* a thousand, the economies necessary to reach this lower price being brought about by making the gas in the holder at 9*d.* to 9½*d.* a thousand and distributing it at a considerably increased pressure, the pressure being regulated down to 1½ inches at the entrance to the consumer's meter.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. B. N. Cama, St. John's College, has been elected to the Isaac Newton studentship in optics and physical astronomy.

The Smith's prizemen are Mr. H. Knapman, Emmanuel, second wrangler 1901, and Mr. A. P. Thompson, Pembroke, fifth wrangler 1901. Mr. W. H. Jackson, Clare, bracketed third wrangler 1901, receives honourable mention.

The following have been appointed as representatives of the University to the joint committee of the Royal Society for the purpose of securing an appropriate memorial of the late Sir G. G. Stokes:—The Chancellor, the Vice-Chancellor, Profs. Jebb, Forsyth, Darwin, Ball, Thomson and Mr. W. Burnside.

THE Sedgwick Memorial Museum syndicate, in an amended report, estimates that the cost to the University of the new building, over and above the amount contributed from the memorial fund, will be not less than 18,480*l.*

IT is stated that Mr. David Davies, of Llandinam, grandson of the late millionaire, has presented the University College of Wales, Aberystwyth, with a sum of 20,000*l.*

THE New York correspondent of the *Daily Mail* announces, on the authority of the *New York Journal*, that Mr. Carnegie has arranged to present 200,000*l.* to Princeton University as a thank-offering for his recovery from his recent illness.

LORD AVEBURY will take the chair on March 17 at a conference on higher education at the Institution of Mechanical Engineers, Storey's Gate, Westminster. Representatives of the county and county borough councils and

other educational bodies have been invited to attend the conference by the National Association for the Promotion of Technical and Secondary Education.

In connection with the seventeenth annual Exhibition of Arts, Crafts and Industries, which will be opened on May 4 in the Town Hall, Hammersmith, by the Duchess of Argyll, a special "nature-study" section has been organised by Mr. W. M. Webb. Prizes and certificates are offered to pupils in schools in Hammersmith for exhibits illustrating, among other subjects, rambles or visits to a park, nature-study diaries, pea plants grown in pots with descriptions of their growth, drawings of living plants or animals, the life-history of any animal (in the wide sense of the word) from personal observation, and nature-study photographs.

The committee of the Bombay University, appointed to consider the recommendations of the recent Universities Commission, has, we learn from the *Pioneer Mail*, come to the conclusion that both the Senate and the Syndicate work satisfactorily and need not be changed; second-grade colleges should not be disaffiliated; a limit of age and minimum fees should not be fixed, and the study of law should not be concentrated in a central college. Moreover, the Senate objects to interference from outside with the courses of study, and considers that the University should be allowed to control such matters in its own way.

The Johnston Laboratory at University College, Liverpool, built and equipped by Mr. William Johnston, of Bromborough, will be opened by the President of the Local Government Board on May 9. The laboratory will contain the following departments:—Bio-chemistry, under the direction of Prof. Benjamin Moore; tropical medicine, directed by Prof. Ronald Ross, F.R.S.; experimental medicine and comparative pathology, directed by Dr. A. S. Grünbaum, who will also have charge of the cancer research, for which, as we have already announced, Mr. T. Sutton Timmis recently provided a gift of 10,000*l*. Mr. Johnston has also endowed the professorship of bio-chemistry and three fellowships in various branches of medical research.

Sir Owen Roberts distributed the prizes and certificates to the students of the South-Western Polytechnic on February 23. The report of the principal, Mr. Herbert Tomlinson, F.R.S., was read, and showed the number of adult students in the institute to be rapidly increasing, so much so, indeed, that the volume of work as estimated by the student hours has in the last four years been doubled. During last session upwards of 600 students entered the day colleges for men and women, and nearly 1800 the evening classes. Two years ago large additions, costing 12,000*l*., were made to the buildings, but these proving insufficient, a still further sum of 13,000*l*., provided, like the former sum, by the Trustees of the London Parochial Charities and the London County Council, is now being expended in providing a large hall and further workshop and laboratory accommodation. The long list of successes of students shows that the number of certificates gained during last session was above 150 more than in the previous year, but, as was pointed out by the principal, the proper function of the institute is not merely to prepare students for examinations, but to fit them to earn a living, and the institute owes a good deal of its popularity to the recognition of this by the management.

The address on science workshops for schools and colleges delivered by Prof. H. E. Armstrong, F.R.S., to the Royal Institute of British Architects last month is printed in full in the *Journal* of the Institute (vol. x. No. 6). Prof. Armstrong illustrated his arguments by reference to the new buildings at Horsham for Christ's Hospital School, of which he is a governor. The science buildings occupy practically one side of the quadrangle, and the floor area of the rooms they contain is 10,326 square feet, while that of the ordinary class rooms of the school only reaches 15,482 square feet. The four chief rooms in the science block are called science "workshops," and are distinguished by the names of Cavendish, Dalton, Davy and Faraday, and to each of these are attached certain subsidiary rooms. No lecture room is provided, since it is desired to discourage didactic teaching—a demonstration bench in the workshop amply provides for any such teaching as is necessary. No special balance room has been introduced, but instead a balance bench—a long narrow table covered by a glazed case for the protection of balances, and arranged at right angles to the working benches. A store or stock room is attached to each of the workshops. There are two kinds of working benches, those for ordinary work and those at which work involving the use of water may be done. The former have teak tops, and the latter are covered with lead. In the rooms on the upper floor, all sinks have been placed near to the walls, and the waste is carried down to the floor below in pipes fixed in chases in the walls. On the basement floor, cross channels have been avoided as much as possible. In three rooms an arrangement has been adopted which provides both a gas service and upright supports to which rings, &c., can be clamped. The space below the bench-top is fitted with two tiers of small cupboards; inside each cupboard is a small drawer. Each bench has four such cupboards, so that four pupils may occupy the place in succession, and each have a cupboard. Prof. Armstrong also gives invaluable hints as to the construction of sinks, drains and ventilation hoods, and describes some special appliances which are in use at Christ's Hospital School. The address concludes with a plea for the simplification of school workshops, and the recommendations are well summed up in Prof. Armstrong's own words, "in designing science workshops the architect . . . should have three S's in mind—*Sense, Simplicity* and *Space.*"

SCIENTIFIC SERIAL.

American Journal of Science, February.—Good seeing, by S. P. Langley. A study of the conditions necessary to the formation of a tranquil image in a telescope (see p. 400).—Native arsenic from Montreal, by N. N. Evans. The native arsenic was found in a vein of nepheline syenite at the Corporation Quarry, near Montreal. On analysis it proved to contain 98·14 per cent. of arsenic, 1·65 per cent. of antimony, with traces of sulphur.—Electromotive force in plants, by A. B. Plowman. The experiments described show that the functional activities of a plant give rise to differences of electrical potential in its parts, the intensity and relative sign of these differences depending upon the physiological condition of the plant, as well as upon its electrical conductivity.—The ionisation of water nuclei, by C. Barus.—The morphogenesis of Platystrophia. A study of the evolution of a Palæozoic Brachiopod, by E. R. Cumings.—Note on the condition of platinum in the nickel-copper ores from Sudbury, by C. W. Dickson. An account of the isolation of sperrylite, platinum arsenide, from chalcopyrite.—Lecture experiment on surface tension and surface viscosity, by J. E. Burbank.—Mylagaulodon, a new rodent from Oregon, by W. J. Sinclair.—Studies in the Cyperaceæ, by T. Holm. On *Carex fusca* and *Carex bipartita*.

SOCIETIES AND ACADEMIES.

London.

Physical Society, February 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—A paper by Prof. **Fleming** and Mr. **Clinton,** on the measurement of small capacities and inductances, was read by Prof. Fleming. The measurement of small capacities and inductances has become important in connection with Hertzian wave wireless telegraphy. The authors have designed a rotating commutator which renders the measurement of small capacities a matter as easy as the measurement of resistance on a Wheatstone bridge. The appliance is described in the paper, and the authors claim that they have worked out a thoroughly satisfactory form of rotating commutator, designed more from the point of view of an engineer than an electrical instrument maker. For use with the instrument a moving-coil differential galvanometer has been designed. The authors have made a number of experiments upon the capacity of aërial wires, such as are used in Hertzian wave telegraphy, and have also investigated the laws governing the capacity of such wires when grouped together in certain ways and verified experimentally, as far as possible, the formulæ for the capacity of insulated wires in various positions in regard to the earth. The experiments are given at length in

the paper, and the results practically obtained are compared with those derived from theoretical considerations. In all cases the total measured capacity of n wires is less than n times the capacity of one wire.—Mr. A. **Campbell** exhibited the commutator used for condenser tests at the National Physical Laboratory. It is similar to that designed by Mr. Searle and used by him and Prof. J. J. Thomson in their determination of the value of "v." In this commutator the ebonite insulation does not fill the spaces between the segments, and is never touched by the brushes, thus giving satisfactory insulation. By its aid many measurements have been made of the B.A. air-condensers, the capacity of each of these being about 0·02 m.fd.—A paper on the thickness of the liquid film formed by condensation at the surface of a solid was read by Dr. G. J. **Parks.** It was known more than half a century ago that when a solid is placed in a gas or vapour there is a condensation of the latter on the surface of the solid, and in particular that glass has the power of condensing water-vapour at temperatures above the dew-point. In order to determine the thickness of the liquid film, the author has exposed masses of cotton-silicate of known area to the action of water-vapour. The author has compared his results with those obtained by other experimenters with different substances and under widely different conditions, and concludes that in all cases where condensation of moisture takes place at a solid surface, and at temperatures not below the dew-point, the thickness of the surface-film varies from 10×10^{-6} to 80×10^{-6} cms., according to the substances used and the conditions of temperature and pressure.

Chemical Society, February 18.—Prof. J. Emerson Reynolds, F.R.S., president, in the chair.—The following papers were read:—The molecular arrangement of *N*-substituted imino-ethers, by Dr. G. D. **Lander.** The rearrangement of the atomic grouping .C(OR) : N. into .CO.NR. may be effected catalytically or by heating; the author has applied these methods to the study of *N*-substituted imino-ethers recently prepared by him.—The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds, by Dr. G. D. **Lander.**—The chlorine derivatives of pyridine. Part viii. The interaction of 2 : 3 : 4 : 5-tetrachloropyridine with ethyl sodiomalonate, by Messrs. W. J. **Sell** and F. W. **Dootson.**—The biological method for resolving inactive acids into their optically active compounds, by Drs. A. **McKenzie** and A. **Harden.** The authors have investigated the action of pure cultures of *Penicillium glaucum*, Link; *Sterigmatocystis nigra*, van Tieghem; *Aspergillus griseus*, Link, on various externally compensated acids. Their experiments show that these moulds attack one isomeride more readily than the other, and that the extent of the resolution depends solely on the difference of this rate of attack.—Colour changes observed in solutions of cobalt chloride, by Prof. W. N. **Hartley,** F.R.S. Spectroscopic examination of solutions of cobalt chloride shows that the compound formed when the solution is heated at 93°-100° is the dihydrate $CoCl_2,2H_2O$, whilst solution of the salt in hydrochloric acid appears to result in the production of a compound of the salt and acid; when zinc chloride is added to a solution of cobalt chloride the latter does not become blue on warming; this, it is suggested, is due to the formation of a double chloride of the two metals. The author also points out that the hypothesis that hydrated salts can exist in concentrated solutions and undergo dissociation with rise of temperature is sufficient to account for all the phenomena observed, and the supposition made by Donnan and Bassett of the existence of a complex ion during the electrolysis of cobalt chloride is unnecessary.—The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids, by Dr. S. **Ruhemann.**—Derivatives of *p*-aminoacetophenone, by Dr. F. D. **Chattaway.** A description of a number of acyl derivatives of this amino-ketone.

Entomological Society, February 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Dr. T. A. **Chapman** exhibited two male specimens of *Orina tristis*, var. *smaragdina*, taken at Pino, Lago Maggiore, on May 30, 1902, still alive; and living larvæ of *Crinopteryx familiella*, second generation, bred from the egg at Reigate, of parents taken at Cannes in February, 1901.—The Rev. F. D. **Morice** exhibited, with drawings of the abnormal parts, a hermaphrodite of *Eucera longicornis*, Linn. In a discussion on hermaphroditism, Dr. Sharp stated that Father Wasman had announced the discovery that in certain Dipterous parasites of Termites the individual commences as a male and ends as a female—a phenomenon entirely new to entomology, though paralleled in some other groups.—Mr. R. **McLachlan,** F.R.S., exhibited a living example of *Chrysopa vulgaris*, Schnd., to show the manner in which this species, which is ordinarily bright green, assumes a brownish colour, the abdomen being often marked with reddish spots in hybernating individuals.—Mr. W. J. **Lucas** submitted specimens of a bug—*Miris calcaratus*—and the fruit of some grass, swept up near Byfleet. The similarity of form and colouring constituted a probable case of protective resemblance.—Major Neville **Manders** exhibited two specimens of an undescribed species of Atella from Ceylon, and remarked that it was a very local insect and only found in the Nitre Cave district, one of the localities most remote from civilisation in the island. It was probably a well-marked local race of *A. alcippe*, but easily distinguished from any known species of the genus by the apex of the fore-wing being entirely black.—Mr. F. B. **Jennings** exhibited two females of *Drymus pilipes*, Fieb., a rare species of the family Lygæidæ, which were found among dead leaves on a hillside near Croydon in September, 1901, and a black aberration of the ordinarily grass-green or yellowish *Miris laevigatus*, L.—Mr. H. J. **Elwes,** F.R.S., exhibited a collection of butterflies formed by Mr. David Hanbury on the Arctic coast of North America, in the region where the Parry expedition was lost. Two of them, including *Colias boothii*, had not been taken since they were first described by Curtis sixty years ago. This species, in comparison with *Colias hecla*, Lef., is undoubtedly distinct in both sexes, but it is most remarkable that the male, in coloration and markings, appears to approximate more closely to the characters usual in the females of other members of the genus. The collection contained nothing new, but included the rare and curious *Argynnis improba*, Butler, hitherto taken only in Novaya Zembla; a remarkable aberration of *A. chariclea*, Schn., in which the black netting marks were resolved into smeared black lines; *A. pales*, for the first time from this region, precisely similar to the form taken on the east of the Lena River in Siberia; and *Coenonympha tiphon*, closely resembling the form from Kamtschatka. He also showed a collection from north-eastern Siberia at about the same latitude, 67°, as the preceding exhibit. It included many species which occur in the western palæarctic regions, most remarkable of all, *Neptis lucilla*. Also *Parnassius delius*, which Mr. Elwes said was the first Parnassius he had seen from within the Arctic circle, and *Colias viluiensis*, Mén., an insect peculiar to Siberia, showing remarkable female aberrant forms.—Mr. C. O. **Waterhouse** gave an account of a nest of a bee, *Trigona collina*, recently received from Malacca. Specimens were exhibited, as were also males and a worker of the much smaller species, *Trigona ruficornis*, Smith, received at the same time from Singapore, and sent by Mr. H. N. Ridley.—Mr. W. J. **Kaye** exhibited two drawers containing Danaine, Ithomiine and Heliconine species from British Guiana, all of similar coloration, and forming a Müllerian association with a black hind-wing.—The following papers were communicated:—On the Hypsid genus Deilemera, Hübner, by Colonel Charles **Swinhoe.**—An account of a collection of Rhopalocera made in the Anambara Creek in Nigeria, West Africa, by Mr. P. J. **Lathy.**—Some notes on the habits of *Nanophyes durieui*, Lucas, as observed in Central Spain by Mr. G. C. **Champion** and Dr. T. A. **Chapman,** with a description of the larva and pupa by Dr. T. A. Chapman.

Zoological Society, February 17.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—A communication was read from Mr. F. **Pickard-Cambridge** containing descriptions of one new genus and eight new species of spiders of the families Pisauridæ and Senoculidæ, the material for which was contained in the British Museum, and was, to a great extent, obtained by the author in the Lower Amazons.—A communication from Mr. Cyril **Crossland** contained descriptions of two new species of marine polychæte worms obtained on the shores of the Island of Zanzi-

bar, in East Africa.—A communication was read from Dr. Robert **Broom** on the axis, atlas and proatlas of the higher Theriodonts. A description of these bones in the type specimens of Gomphognathus and Trirachodon, now preserved in the Grahamstown Museum, was given, and suggestions thrown out as to the relationship of these forms and Procolophon to the modern Sphenodon and crocodiles.—Mr. C. Tate **Regan** contributed a paper entitled "A Revision of the Fishes of the Genus Triacanthus," in which seven species were described, one of them, *T. indicus*, being new to science.—Mr. G. A. **Boulenger**, F.R.S., read a paper on the geographical variations of the sand-viper (*Vipera ammodytes*), in which he distinguished a geographical race (var. *meridionalis*) from Greece, the Archipelago and Syria, from the typical form found in Austria-Hungary and Bosnia.—Mr. F. G. **Parsons** read an account, drawn up by Mr. George Candler, of the habits of the hoolock (*Hylobates hoolock*), as observed by him in the forests of Cachar, in north-east India.

MANCHESTER.

Literary and Philosophical Society, February 3.—Mr. Charles Bailey, president, in the chair.—Prof. Osborne **Reynolds**, F.R.S., exhibited and explained some models illustrating his mechanical theory of the structure of the universe, propounded in his paper on the submechanics of the universe, read before the Royal Society.—Mr. C. E. **Stromeyer** read a paper on parallax determinations by photography, in which he dealt with the advantages photography offers for rapid and accurate surveys. The principle recommended was to superimpose the image of a photographic negative taken at one position on the image of a photographic positive taken at another position, the parallax, or angle which separates two positions as seen from any of the objects in the photographs, being measured micrometrically by shifting one of the images until the object registers and disappears. It was suggested that the best results would be obtained by placing the two photographs in two lanterns and superimposing the images on a screen or into a microscope eyepiece, but the instrument shown was arranged to suit a single lantern, the negative and the positive being placed film to film.—Mr. W. B. **Baron** read a paper (communicated by Mr. Stromeyer) on the influence of hydrogen in fuel on the composition of the resulting flue gases. He showed that by making the gas analysis, usually undertaken in boiler trials, with little more than ordinary care, and applying various corrections thereto, the relation of hydrogen to other combustible in the fuel can be accurately found.

DUBLIN.

Royal Dublin Society, February 17.—Pro.. J. Joly, F.R.S., in the chair.—Dr. G. Johnstone **Stoney**, F.R.S., read a paper entitled "How to Introduce Order in the Relations between British Weights and Measures." The paper describes a proposal for legislation which the author submitted two years ago to the Board of Trade. Its aim is to get rid of the irrationality between the two methods of measurement, without its being necessary for Parliament to call upon the inhabitants of this country to make any change in their habits of thought, or the practice to which they are accustomed, until they themselves choose to do so. The main parts of the proposal are that an Act be passed making the yard exactly nine-tenths of the metre, the avoirdupois pound exactly nine-tenths of the metric pound or half kilogram, and the imperial gallon exactly nine-tenths of the metric gallon or half dekalitre. They at present differ from these amounts by small but very troublesome fractions.—Mr. David **Houston** communicated a paper on the value of bacteriological tests in judging the butter exhibited at agricultural shows. The author had submitted all the butter exhibits that had gained prizes at the Society's winter show at Ball's Bridge to a detailed bacteriological examination, and had also visited many of the contributing creameries with the object of checking laboratory results. The experiments, it was claimed, proved the fallacy of ordinary methods of judging the quality of butter, and demonstrated the utility of bacteriological tests, at least as an auxiliary to the usual method, in determining the real value of butter.—Mr. G. H. **Carpenter** read a paper on injurious insects and other animals observed in Ireland during the year 1902. The most important records were the flour moth (*Ephestia Kuehniella*) in Belfast Mills, and a new species of Australian weevil (*Syagrius intrudens*, Waterh.) as a greenhouse pest in the Royal Botanic Gardens, Glasnevin. Mention was also made of the injury to various vegetable stems and roots by Enchytræid worms.—Dr. Henry H. **Dixon** presented two criticisms on the cohesion theory of the ascent of sap. In this paper Steinbrinck's objection, based on the permeability of the walls of the conducting tubes to air, is shown to be invalid. Air passing through the wet walls must be in solution, and it has been shown by experiment that saturation of water by air does not appreciably lessen its tensile strength. Secondly, Copeland's criticism, founded on experiments made with plaster of Paris, is shown to involve perpetual motion. The true explanation of Copeland's results is to be found in the continued absorption of plaster of Paris after setting, combined with its great resistance to the passage of water.

PARIS.

Academy of Sciences, February 23.—M. Albert Gaudry in the chair.—The law of electromotive forces in saline solutions: the influence of temperature, by M. **Berthelot**.—On tuberculosis and diaphysis of the long bones of the limbs and its treatment, by M. **Lannelongue**. If the tuberculous abscess or tuberculome is not too large, a cure may be effected by a simple washing with an antiseptic liquid containing iodoform, creosote, ether and olive oil. In more severe cases the abscess must be opened, and the whole of the inside surface scraped with a cuvette. If due care is taken, the abscess is not liable to recur.—The action of a polarised bundle of very refrangible radiations on very small electric sparks, by M. R. **Blondlot**. The action of the X-rays from a focus tube upon an electric spark has shown that these rays are polarised; it appeared to be of interest to see if a similar action could be traced in the case of a bundle of polarised light rays. The whole of the experiments described show that a bundle of polarised light rays produces a notable reinforcement of the spark when its plane of polarisation is normal to the spark, and does not act on it when its plane of polarisation is parallel to it; in other words, there is a plane of action of polarised light upon the small spark, and this plane is normal to the plane of polarisation.—Prof. Koch was elected a foreign associate in the place of the late Prof. Virchow.—On a particular class of triple orthogonal systems, by M. C. **Guichard**.—On the resistance of perfect gases to the movement of solids, by M. L. **Jacob**.—A hydro-tachymeter for regulating hydraulic turbines, by M. L. **Ribourt**. The new form of governor, a description of which with drawings is given, has worked very satisfactorily in practice. In that form of turbine most difficult to regulate, small power with a low fall, the variations of velocity have been kept constant within 2 per cent., although the variations of resistance amounted to 30 per cent.—The variations in the modulus of elasticity in nickel steels, by M. C. E. **Guillaume**. The method employed consisted in observing at different temperatures a chronometer furnished with a spiral of the alloy under examination mounted on a brass balance. Alloys containing 26 per cent. and 45 per cent. of nickel possessed the smallest temperature coefficient.—On the spontaneous reduction of the amount of carbon in steel, by M. G. **Belloc**. The sudden heating of a hard steel wire spiral in a vacuum gives a greyish metal, soft and incapable of being tempered. This effect appears to be intimately connected with the presence of occluded gases, since it is not produced if occluded gases are absent.—On the influence of certain modes of treatment on the microscopic structure of certain nickel steels, by M. Léon **Guillet**. Micrographic observations show the effects of tempering, annealing and hammering on nickel steels more clearly than mechanical tests, and in shorter time.—On the products of reduction of copper salts by hydroxylamine, by M. E. **Péchard**. An ammoniacal solution of copper sulphate is decolorised by sulphate of hydroxylamine, nitrogen and nitrous oxide being evolved. From an ammoniacal solution of copper acetate cuprous acetate can be readily obtained by hydroxylamine sulphate.—The action of urea upon pyruvic acid, by M. L. J. **Simon**.—On some phosphorus derivatives of benzophenone and

methyl-propyl-ketone, by M. C. **Marie.** The phosphorus compounds described were obtained by heating together hypophosphorous acid and various ketones.—On the results obtained in the distillery by the application of yeasts acclimatised to the volatile toxic principles present in the molasses from beetroot, by M. Henri **Alliot.** Satisfactory results have been obtained in practice by the use of acclimatised yeasts, the alcoholic fermentation taking place in a liquid not only containing substances detrimental to yeasts, but also contaminated with foreign bacteria.—Experimental researches on epithelial hyperplasia and on the transformation of epithelium into conjunctive tissue, by M. Ed. **Retterer.** The irritation which produces on the epidermis the loosening of the skin gives rise to evolutive phenomena which recall very nearly those of cartilage in the course of ossification. The cells proliferate and give rise to new cells, which are transformed into reticular and vascular conjunctive tissue.—The series of the genus Absidia, by M. Paul **Vuillemin.**—On the interpretation of the arrangement of the bundles in the petiole and leaf veins of the dicotyledons, by M. **Col.**—Eruptions of the secondary period in the Island of Crete, by M. L. **Cayeux.** The eruptive rocks in Crete form a part of the strata which have been identified with the Upper Jurassic. The eruptive rocks have metamorphosed the upper strata in which they are included, and leave absolutely untouched the more recent strata.—The lower Devonian in the region of Kosva (Northern Ural), by MM. L. **Duparc,** L. **Mrazec** and F. **Pearce.**—On the faults at Poitou, between Parthenay, Niort and Poitiers, by M. Jules **Welsch.**

DIARY OF SOCIETIES.

THURSDAY, March 5.

Royal Society, at 4.30.—The Resistance of the Ions and the Mechanical Friction of the Solvent: Prof. F. Kohlrausch, For. Mem. R.S.—The Electrical Conductivity of Solutions at the Freezing Point of Water: W. C. D. Whetham, F.R.S.—A Note on a Form of Magnetic Detector for Hertzian Waves adapted for Quantitative Work: Prof. J. A. Fleming, F.R.S.—On the Laws Governing Electric Discharges in Gases at Low Pressures. Communicated by Prof. J. J. Thomson. F.R.S.: W. R. Carr.—The Differential Invariants of a Surface, and their Geometric Significance: Prof. A. R. Forsyth, F.R.S.

Royal Institution, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

Society of Public Analysts, at 8.

Chemical Society, at 8.—The Mechanism of the Reduction of Potassium Bichromate by Sulphurous Acid: H. Bassett.—The Constitution of Pilocarpine. Part IV.: H. A. D. Jowett.—Preparation and Properties of 1:4 (or 1:5)-Dimethyl Glyoxaline and 1:3-Dimethyl Pyrazole: H. A. D. Jowett and C. E. Potter.—Some Analyses of "Reh," or the Alkaline Salts in Indian Usar Land: E. G. Hill.—Experiments on the Synthesis of Camphoric Acid. Part III. Synthesis of Isolauronolic Acid: W. H. Perkin, Jun., and J. F. Thorpe.—Camphor-β-thiol: T. M. Lowry and G. C. Donington.—Isomeric Change of Dibenzanilide into Benzoyl-*o*-amino- and Benzoyl-*p*-amino-benzophenone: F. D. Chattaway.—The Rate of Decomposition of Diazo-compounds. Part III. The Temperature Coefficient: J. C. Cain and F. Nicoll.

Linnean Society, at 8.—On some Points in the Visceral Anatomy of the Characinidæ: W. S. Rowntree.—On the Anatomy of the Pig-footed Bandicoot *Chaeropus castanotis*: F. G. Parsons.—Further Notes on Lemurs: Dr. Elliot Smith.

Röntgen Society, at 8.30.—Spark Phenomena: F. H. Glew.

FRIDAY, March 6.

Royal Institution, at 9.—Studies in Experimental Phonetics: Prof. J. G. McKendrick, F.R.S.

Geologists' Association, at 8.—The Pliocene Bone Bed of Concud, Teruel, Spain: Dr. A. Smith Woodward, F.R.S.—On the Zones of the Upper Chalk in Suffolk: A. J. Jukes-Browne.

SATURDAY, March 7.

Royal Institution, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY, March 9.

Society of Arts, at 8.—Hertzian Wave Telegraphy in Theory and Practice: Prof. J. A. Fleming, F.R.S.

Royal Geographical Society, at 8.30.—A Buried Landscape in the English Midlands: Prof. W. W. Watts.

TUESDAY, March 10.

Royal Institution, at 5.—Recent Advances in Photographic Science: Sir William Abney, K.C.B.

Institution of Civil Engineers, at 8.—Recent Irrigation in the Punjab: S. Preston.—The Irrigation Weir across the Bhadar River, Kathiawar: J. J. B. Benson.

WEDNESDAY, March 11.

Society of Arts, at 8.—Existing Laws, By-Laws and Regulations relating to Protection from Fire, with Criticisms and Suggestions: T. Brice Phillips.

Geological Society, at 8.—Petrological Notes on Rocks from Southern Abyssinia collected by Dr. R. Koettlitz: Dr. Catherine A. Raisin.—The Overthrust Torridonian Rocks of the Isle of Rum and the Associated Gneisses: Alfred Harker, F.R.S.

THURSDAY, March 12.

Royal Society, at 4.30.—*Probable Papers*:—On the Histology of *Uredo dispersa*, Erikks., and the "*Mycoplasm*" Hypothesis: Prof. Marshall Ward, F.R.S.—A Study of a Unicellular Green Alga, occurring in Polluted Water, with Especial Reference to its Nitrogenous Metabolism: Miss H. Chick.—A Comparative Study of the Grey and White Matter of the Motor Cell Groups and of the Spinal Accessory Nerve in the Spinal Cord of the Porpoise (*Phocaena communis*): Dr. D. Hepburn and Dr. D. Waterston.—The Oestrous Cycle and the Formation of the Corpus Luteum in the Sheep: F. H. A. Marshall.—On the Culture of the Nitroso-bacterium: H. S. Fremlin.—Upon the Immunising Effects of the Intracellular Contents of the Typhoid Bacillus as Obtained by the Disintegration of the Organism at the Temperature of Liquid Air: Dr. A. Macfadyen.

Royal Institution, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

Institution of Electrical Engineers, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms (abstract): M. B. Field.

Society of Arts, at 4.30.—The Currency Policy of India: J. Barr Robertson.

Mathematical Society, at 5.30.—On the Convergence of Certain Multiple Series: G. H. Hardy.—On the Representation of a Group of Finite Order as an Irreducible Group of Linear Substitutions and the Direct Establishment of the Relations between the Group-Characteristics: Prof. W. Burnside.—Approximate Calculation of the Periods of Vibration of a Circular Plate: Prof. H. Lamb.—Mathematical Notes: Dr. H. F. Baker.

FRIDAY, March 13.

Royal Institution, at 9.—Character Reading from External Signs; Prof. Karl Pearson, F.R.S.

Physical Society, at 5.—On the Interpretation of Milne Seismograms: Dr. Farr.—A Potentiometer for Thermocouple Measurements: Dr. R. A. Lehfeldt.—A Direct-Reading Potentiometer for Thermoelectric Work: Dr. J. A. Harker.—The Measurement of Small Resistances: A. Campbell.—A Resistance Comparator: Dr. R. A. Lehfeldt.

Malacological Society, at 8.—Further Description of the Animal of *Damayantia carinata*, Collinge: Lieut.-Col. H. H. Godwin-Austen, F.R.S.—Note on the Generic Name Buliminus: B. B. Woodward.—Notes on Pleistocene Non-marine Mollusca from Portland Bill; and on Holocene Non-marine Mollusca from Wilts, Dorset Cambridgeshire and Folkestone: R. Ashington Bullen.—On the Occurrence of *Neritina Grateloupiana*, Fér., in the Pleistocene at Swanscomb: A. S. Kennard and B. B. Woodward.

Institution of Civil Engineers, at 8.—Reconstruction of Midland Railway Bridge No. 27, over the the River Trent: A. R. Langton.

SATURDAY, March 14.

Royal Institution, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 12, 1903.

THE UNIVERSITY IN THE MODERN STATE.[1]

II.

WHAT Germany thinks of the place of the university in a modern State can be readily gathered from the large and ever-increasing State endowments of the numerous universities in Prussia and the other constituent countries.

The university activity of Prussia itself dates from the time after Jena, 1806, when the nation was, as Sir Rowland Blennerhassett has told us, a bleeding and lacerated mass, so impoverished and shattered that there seemed to be little future before it. King Frederick William III. and his councillors, among them Wilhelm von Humboldt, founded the University of Berlin, "to supply the loss of territory by intellectual effort." Among the universal poverty, money was also found for the Universities of Koenigsberg and Breslau, and Bonn was founded in 1818. Observatories and other scientific institutions were not forgotten. As a result of this policy, carried on persistently and continuously by successive Ministers, aided by wise councillors, many of them the products of this policy, such a state of things was brought about that Palmerston, a typical English statesman, is stated by Matthew Arnold to have defined the Germany of his day as a country of "damned professors," and so well have the damned professors done their work since that not long ago M. Ferdinand Lot, one of the most distinguished educationists of France, accorded to Germany "a supremacy in science comparable to the supremacy of England at sea."

The whole history of Prussia since then constitutes indeed a magnificent object lesson on the influence of brain-power on history. There can be no question that the Prussia of to-day, the leader of a united Germany, with its armed strength both for peace and war and craving for a wider world dominion, is the direct outcome of the policy of "intellectual effort" inaugurated in 1806.

The most remarkable thing about the German universities in later years is the constant addition of new departments, added to enable them to meet and even to anticipate the demands made for laboratories in which each scientific subject, as it has been developed, can be taught on Liebig's plan, that is by experiment, observation and research.

It is in such State-aided institutions as these that the members of the German Ministry and Parliament, and the leading industrials are trained, while in our case, in consequence of the lack of funds for new buildings at Oxford and Cambridge, and, until not many years ago, the lack of other high-teaching centres, our leaders have had to be content with curricula extant before Galileo was born, the teaching being, perhaps, not so good and the desire to learn generally much less.

No one will deny that the brain-power of a nation must, in the last resort, depend upon the higher mental training obtainable in that nation. It is well, therefore, to see how we stand in this matter.

The following tables will show what the German Government is doing to provide brain-power in Germany. Those who know most about our British conditions will see how we are likely to fare in any competition with Germany in which brain-power comes in, if indeed there can be any important sphere of activity undertaken by either King, Lords or Commons in which brain-power does *not* come in.

We owe the first table giving the facts relating to the ordinary State endowments of the twenty-two German universities to the kindness of Mr. Alexander Siemens, who was good enough to obtain through official sources an extract from the "Preussische Statistik" containing an article by Dr. Petersilie. This deals with 1891–2, the last year dealt with by the statistical bureau.

TABLE I.—*Ordinary State Endowment, Year* 1891–2.

Universities.	Ordinary Total Income of Universities.	Sources of Income. Foundation Funds, Fees, &c.	State Funds.	Other Sources.	Percentage of Foundation Funds.	Percentage of State Funds.	Expenditure. Salaries of Teaching Staff (including Lodging Allowance).	Various Personal Expenses.	Expenses Connected with Material.
a. Prussian Universities.	£	£	£	£			£	£	£
1. Berlin	123,839	16,782	107,057	—	14	86	44,504	23,769	55,565
2. Bonn	56,467	10,661	45,806	—	19	81	24,404	8,334	23,729
3. Breslau	48,203	3,454	44,749	—	7	93	21,845	7,927	18,430
4. Göttingen	57,363	36,487	20,877	—	64	36	24,601	10,248	22,512
5. Greifswald	35,807	21,833	13,974	—	61	39	14,605	5,870	15,332
6. Halle	62,880	29,596	33,284	—	47	53	20,791	9,015	33,073
7. Kiel	37,722	9,584	28,188	—	25	75	13,471	5,682	18,618
8. Königsberg	46,405	6,475	39,930	—	14	86	17,193	7,374	21,836
9. Marburg	38,872	8,743	30,129	—	22	78	15,068	6,732	17,070
10. Munster Academy ...	12,312	4,202	8,110	—	34	66	8,000	1,737	2,574
11. Braunsberg Lyceum	2,040	1,046	994	—	51	49	1,741	82	216
Prussian Universities altogether ...	521,911	148,863	373,098	—	33	67	206,223	86,770	228,955

[1] Continued from p. 196.

TABLE I.—*Continued.*

Universities.	Ordinary Total Income of Universities.	Sources of Income. Foundation Funds, Fees, &c.	State Funds.	Other Sources.	Percentage of Foundation Funds.	Percentage of State Funds.	Expenditure. Salaries of Teaching Staff (including Lodging Allowance).	Various Personal Expenses.	Expenses Connected with Material.
b. Other than Prussian Universities.	£	£	£	£	£	£	£	£	£
1. Munich	45,678	13,069	32,609	—	29	71	24,669	10,981	10,028
2. Wurzburg	36,246	15,707	20,539	—	43	57	14,099	11,316	10,831
3. Erlangen	31,722	6,813	24,909	—	21	79	11,591	10,149	9,982
4. Leipzig	99,373	21,439	77,934	—	22	78	27,162	43,917	28,293
5. Tubingen	44,068	5,309	38,759	—	12	88	13,669	12,602	17,798
6. Freiburg	25,984	3,996	21,893	95	16	84	13,021	3,538	9,424
7. Heidelberg	34,949	987	33,895	67	3	97	16,569	3,541	14,839
8. Giessen	32,749	9,530	23,178	41	29	71	11,988	2,358	18,402
9. Rostock	16,614	113	16,290	211	2	98	7,722	795	8,097
10. Jena	—	—	—	—	—	—	—	—	—
11. Strassburg	49,750	3,917	45,575	257	8	92	26,300	3,611	19,838
Non-Prussian Universities altogether, excluding Jena ...	— 417,133	80,880	335,581	671	19	81	166,790	102,808	147,532
Prussian Universities	521,911	148,863	373,098	—	33	67	206,223	86,770	228,955
All the German Universities, excluding Jena ...	939,044	229,743	708,679	671	26	74	371,013	189,578	376,487

In the second table are given the *extraordinary* expenses incurred in the same year, also obtained from Dr. Petersilie's article. There have been added the State endowments for the years 1900–1 and 1902–3, so far as it has been possible to obtain them from "Minerva," in order that the considerable yearly increase in the endowments may be noted.

TABLE II.—*Showing Extraordinary Expenditure* 1891–2, *and Increase of Ordinary Endowment since then.*

Universities.	Ordinary State Endowment, 1891–2.	Extraordinary Expenditure Provided by the State in 1891–2.	Ordinary State Endowment, 1900–1.	Ordinary State Endowment, 1902–3.	Increase of Ordinary State Endowment in 11 years (in thousands).
a. Prussian Universities.	£	£	£	£	£
1. Berlin	107,057	61,714	130,743	142,155	35
2. Bonn	45,806	9,690	51,982	56,091	11
3. Breslau	44,749	38,900	57,435	57,435	13
4. Göttingen	20,877	6,260	27,403	30,414	10
5. Greifswald	13,974	5,762	20,490	23,925	10
6. Halle	33,284	15,919	51,666	54,419	21
7. Kiel	28,188	5,690	37,286	41,891	13
8. Königsberg	39,930	12,350	47,069	50,936	11
9. Marburg	30,129	2,660	36,255	38,931	8
10. Munster Academy	8,110	300	14,364	18,242	10
11. Braunsberg Lyceum	994	—	1,989	2,990	2
Prussian Universities: totals ..	373,098	159,245	476,682	517,429	144
b. Other than Prussian Universities.					
1. Munich	32,609	13,932	—	—	
2. Wurzburg	20,539	375	—	—	
3. Erlangen	24,909	3,766		—	
4. Leipzig	77,934	—	101,989	104,388	27
5. Tubingen	38,759	—	49,703	52,234	14
6. Freiburg	21,893	7,825	28,555	30,955	9
7. Heidelberg	33,895	14,771	39,125	41,225	8
8. Giessen	23,178	6,990	37,480	42,188	19
9. Rostock	16,290	—	17,812	—	
10. Jena	—	—	—	—	
11. Strassburg	45,575	12,440	49,150	49,862	4
Non-Prussian Universities; totals...	335,581	60,099	323,814	320,852	

It will be seen that those responsible for the continued well-being of the German State are as busily employed in increasing the efficiency of their universities as they are in adding to their navy.

In Britain, there is no concern shown by our Government and politicians in regard to the *real* sources of *national* brain-power, towards which primary instruction, now well endowed, is but the first step. Private endowment is still appealed to, though our present unfortunate position comes from the fact that since the necessary introduction of science into the curriculum of the higher teaching, private endowment in the past has not been, nor in the future will it be, able to supply a tithe of what is really wanted.

The State, however, while it allows the universities to remain inefficient, as if it were a matter of indifference whether we fail in brain-competition with foreign countries or not, does really concede the principle of State aid. Its present contribution to our universities and colleges amounts to 155,600*l.* a year; no capital sum, however, is taken for buildings.

This sum is made up of grants to:—

		£
(*a*) 4 universities in Scotland		72,000
3 ,, ,, England		14,800
1 ,, ,, Wales		4,000
(*b*) 13 colleges in England		26,000
3 ,, ,, Wales		12,000
3 ,, ,, Ireland—		
Grants in aid	4,800	
Consolidated Fund; for Salaries of Professors and Officers, and Allowances for Scholars and Prizes	21,000	
		25,800
1 college in Scotland		1,000

The above tables show that the total sum given by the British Government for the whole of the United Kingdom is less now than the State endowment of one of the twenty-two German universities was more than ten years ago.

ASSYRIAN HISTORY.

Annals of the Kings of Assyria: the Cuneiform Texts, with Translations, Transliterations, &c., from the original documents in the British Museum. Edited by E. A. Wallis Budge, M.A., Litt.D., Keeper of the Egyptian and Assyrian Antiquities, and L. W. King, M.A., F.S.A., Assistant in the Department of Egyptian and Assyrian Antiquities. Vol. i. Pp. lxxv+391. (Printed by order of the Trustees, 1902.) Price 1*l.*

IT is an interesting fact that practically all the materials which exist for the reconstruction of the ancient history of Mesopotamia are to be found within the walls of the British Museum. Neither at Paris, nor even at Constantinople, far less at Berlin, does there exist any collection of ancient Babylonian and Assyrian records which can for a moment be compared to that of the British Museum. The researches of British archæologists have resulted in the transfer to London of the whole of the royal library of the palace of King Ashurbanipal (668-626 B.C.) at Nineveh; here the thousands of inscribed clay tablets of which it was composed have found their permanent home. It is then to London that every student must turn if he wishes to learn the story of ancient Mesopotamia. Here are preserved almost all the ancient monuments and records of those mighty monarchs of Assyria and Babylon, who lighten the background of the Biblical story with the splendour of their continual goings forth to war, and the rumour of whose glory makes so deep an impression on the history of Herodotus. The Trustees of the national Museum have now commenced to publish a national and official edition of all the most important of the Assyrian historical records preserved under their care. This edition will contain the original cuneiform texts, with their transliteration, a translation, and extremely useful footnotes and annotations below.

As yet only the first volume has appeared; if we are to judge of those that will follow from the first we may indeed congratulate the Trustees on their important publication—one of the most important, in fact, of their publications for many years past. To say that Dr. Budge, the Keeper of the Assyrian collections, and his able assistant, Mr. L. W. King (already known as an Assyrian historian since he edited "The Life and Letters of King Hammurabi of Babylon," and incidentally demolished the legend that a mention of Chedorlaomer, Tidal, and Arioch had been found on Assyrian tablets), have done their work well is unnecessary; one does not question the results arrived at by the first—almost the only—authorities on the subject. We can only wonder at the perspicacity of those pioneers of cuneiform research, Rawlinson, Hincks, Fox Talbot, George Smith (all Englishmen), and the rest, who made it possible for Dr. Budge and Mr. King to translate for us with such accuracy and *verve* the strange arrow-headed characters which march in procession along the top of each page of their monumental publication. *Verve* the translations undoubtedly have, and this energy of expression exists also in the originals whenever a triumphant war is being described.

It is in this respect that an Assyrian inscription differs greatly from an Egyptian; the Egyptian is a much calmer and quieter recital of events in poetical form, depending for much of its effect on artificial antitheses, alliterations, even on puns, and so losing energy and truth; the Assyrian is the pæan of a dervish, nothing less. Let us hear Tiglath-pileser (1100 B.C.) dancing and singing his war-song over the bodies of his victims (p. 49):—

"With the fury of my valour a second time against the land of Kummukhi I marched. All their cities I conquered; their spoil and their goods and their possessions I carried off; their cities I burned with fire, I laid waste, I destroyed. And the rest of their host, who in face of my terrible weapons were afraid and feared my mighty onslaught in battle, in order to save their lives, sought the strong heights of the mountains, a difficult region. To the heights of the lofty hills and to the tops of the steep mountains, where it was not possible for man to tread, after them I went up. War, and fighting, and battle they waged against me, but I defeated them, and the dead bodies of their warriors on the tops of the mountains like the Storm-god I cast down, and their blood in the valleys and on the high places of the mountains I caused to flow. Their spoil, their goods, and their possessions from the strong heights of the mountain I brought down. The land of Kummukhi in its length and breadth I conquered, and

I added it to the borders of my land. Tiglath-pileser, the mighty king, the snare of the disobedient, who overwhelmeth the resistance of the wicked! With the exalted might of Ashur my lord against the land of Kharia and the wide-spread troops of the Kurtê, over lofty hills which no king had ever reached, Ashur, my lord, commanded that I should march. My chariots and my host I gathered together, and between the mountains of Idni and Aia, a difficult region, I took my way. Among high mountains which were sharp as the point of a dagger, and which were impassable for my chariots, the chariots I left idle, and the steep mountains I traversed on foot. The whole of the Kurtê had assembled their wide-spread troops . . . in the mountain . . . with them I fought and I defeated them; the dead bodies of the warriors on the high places of the mountain I piled up in heaps, and the blood of their warriors in the valleys and on the heights of the mountains I caused to flow. . . . The people of the land of Adaush feared the mighty advance of my battle-array, and they deserted their territory and to the tops of the lofty mountains like birds they fled. . . . Their fighting men on the peaks of the mountain I piled up in heaps, with the blood of their warriors the mountain of Khirikha I dyed red like scarlet wool. Tiglath-pileser, the burning flame, the Terrible One, the storm of battle (am I)!" (p. 72).

Such is an Assyrian war-chronicle. Its fierce energy is no pretence. Nor can we wonder that this virile people were the masters of Western Asia in their time. This inscription dates to the dawn of their hegemony, when they were just beginning to strike the terror of them into the hearts of the kings of the earth. Most of the other inscriptions in this volume are of the same type.

"The soldiers escaped," says Ashur-nasir-pal (B.C. 885-860), "and occupied a steep mountain; the mountain was exceeding steep, and after them I did not go. The peak of the mountain rose like the point of an iron dagger, and no bird of heaven that flieth reacheth thereto. Like the nest of a vulture within the mountain was set their stronghold, into which none of the kings my fathers had penetrated. In three days the warrior overcame the mountain; his stout heart pressed on to battle; he climbed up on his feet, he cast down the mountain, he destroyed their nest, their host he shattered" (pp. 270, 271).

Always the same forcible and picturesque diction, which is well reproduced by the translator.

But the Assyrian monarch was not only a destroyer; he could build up as well as cast down.

"The palaces, the royal dwellings," says Tiglath-pileser (p. 88), "in the great cities of the provinces of my land, which from the time of my fathers during the course of many years had been deserted, and had decayed, and had fallen into ruins, I have rebuilt and restored. The walls of the cities of my land which were in ruins I have strengthened. The engines for watering the fields throughout the whole of Assyria I have repaired, and stores of grain in greater quantities than those of my fathers I have increased and heaped up. . . . Cedars and urkarinu-trees, and allakanish-trees, in the countries which I have conquered, such trees the like of which among the kings my fathers of old time none had ever planted, I took, and in the gardens of my land I have planted them. And rare garden-fruits, which were not found within my land, I took, and in the gardens of Assyria I have caused them to flourish. Chariots and teams of horses, that my land might be strong, more than formerly, I have increased and I have strengthened. Unto the land of Assyria I have added land and unto her peoples, peoples."

These extracts will serve to give some idea of the extremely interesting character of these "Annals of the Kings of Assyria." The present volume contains inscriptions dating from the early period to the reign of Ashur-nasir-pal (B.C 885-860). It is evident that many more volumes of the same size and scope as that which lies before us will have to be published before the editors come to the end of the rich material which lies ready to their hand. For Assyrian history covers another two centuries and a half, occupied by a continuous record of wars, conquests, city and palace building, &c., often containing information of the greatest possible use to the historian.

Isolated matters of interest often crop up in the course of the narrative. Thus we read that Tiglath-pileser I., one of the first of Assyrian kings to reach the Mediterranean, went for a pleasure trip in a Phœnician ship from Arvad, and slew a mighty dolphin in the course of his sail. To the same king the contemporary monarch of Egypt, who must have been one of the immediate successors of Rameses III., of the twentieth dynasty, sent a crocodile as a present, and also a great *pagutu*, whatever that may have been; perhaps it was a hippopotamus. We may wonder what condition the unlucky animals were in by the time they reached Assyria! They were evidently regarded as very remarkable creatures, as we can see from the care with which their arrival is recorded.

The sketch of Assyrian history which precedes the texts is extremely well written, and gives the reader a very good idea of the rise of the famous kingdom on the Tigris.

In conclusion, we must again congratulate the Trustees of the British Museum on their decision to undertake the publication of these important national treasures, and the editors, also, on the excellence of their work.

TRUSTWORTHY REAGENTS.

The Testing of Chemical Reagents for Purity. By Dr. C. Krauch. Third Edition. Authorised translation by J. A. Williamson, F.C.S., and L. W. Dupré. Pp. 350. (London: Maclaren and Sons, n.d.) Price 12*s*. 6*d*. net.

CAVEAT EMPTOR is a good maxim, if a somewhat hackneyed quotation. The principle it embodies need not be disregarded, even by the chemist. True, he is a protector of the purchasing public in certain cases where that public cannot take care of itself; but this does not absolve him from the necessity of keeping a watchful eye upon his own purchases. On the contrary, the very fact that he may be called upon, for instance, to certify to the purity of other people's food makes it all the more incumbent upon him to look well after the purity of his own reagents. It may happen—and it has happened—that through insufficient attention to the quality of his chemicals, an analyst may introduce into some article the very impurity which he is required to search for, or an investigator in pure chemistry may be led to propound some brilliant theory which more circumspect working

presently renders untenable. As examples in point, one need only recall the testing of foodstuffs for arsenic, and the alleged conversion of this element into antimony. Wherefore, when the chemist buys his chemicals let him remember the legal tag above quoted, and not trust too implicitly to the manufacturer who supplies them.

The book before us will help to minimise the labour involved in satisfying oneself on this matter. It deals with some hundreds of reagents used by the chemist, and with a few of those generally employed by the microscopist. As regards its plan, the substances are arranged in alphabetical order, beginning with "acetic acid" and ending with "zinc sulphate." Under each heading are described, very briefly, a few of the more prominent characters of the reagent, such as its formula, molecular weight, boiling point, specific gravity, or crystalline form. Then follow, as a rule, a number of "tests for impurities," in which are indicated the probable foreign substances to be met with in the article under examination, and the characteristic methods of detecting them. A paragraph or two dealing with the "quantitative estimation" of the reagent is added in those cases where the addition is applicable. Following this come notes upon "uses" or "uses and storage," in which mention is made of the purpose for which the reagent is generally required, and hints given as to how it should be kept—*e.g.* whether protected from light, in a cool place, under oil, and so on. Finally the "commercial varieties" of the substance are shortly indicated.

On account of the number of articles dealt with, the information afforded is necessarily for the most part very brief, and is always concisely put. Fairly full descriptions, however, are given in the case of some of the more important reagents: thus ten pages are devoted to alcohols, six to ether, and eight to hydrochloric acid; whilst tables of the strengths corresponding to various values of specific gravity are appended to the sections dealing with such reagents as acetic acid, ammonia, alcohol, and the mineral acids. References, and useful ones, are frequently given to literature in which further information is to be found; and in place of the original German sources the translators have very considerately indicated abstracts and papers to be found in English journals and text-books.

All the ordinary reagents are described, and also a number of those less frequently used. As regards the inclusion of the latter, the present writer has tested the volume in respect of a few of the less common reagents, such as the persulphates, iodeosin, and nitroso-β-naphthol (which latter, by the way, can be recommended for the separation of cobalt from nickel), and finds them duly mentioned except in the case of the persulphate.

The book is hardly one which calls for much criticism. The value of such a work consists in its bringing conveniently together the chief data pertaining to the various substances, so far as they are criteria of purity. If a good selection is made, and if the information is accurate, the book saves labour and fulfils its purpose. Judged by this standard the volume can be unreservedly commended. C. SIMMONDS.

OUR BOOK SHELF.

Text-book of Electrochemistry. By Svante Arrhenius. Translated by John McCrae. Pp. xi + 344. (London: Longmans and Co., 1902.) Price 9*s.* 6*d.* net.

THIS work, by the chief founder of modern electrochemical theory, is worthy of a hearty welcome in its English form. It is distinguished from other works on the same subject by being at once more thorough and more simple, the difference being specially apparent in the chapters dealing with potential and electromotive force. Too often the treatment of this branch of the subject leaves the impression (on the student of chemistry at least) that a simple and important result is arrived at from no premisses in particular by some unconvincing mathematical hocus-pocus, wholly devoid of concrete meaning. Prof. Arrhenius is necessarily somewhat mathematical, but the physical significance of each step is so carefully explained that no attentive student of physics or chemistry, with the most rudimentary knowledge of the calculus, can fail to gain a clear idea of the process of reasoning, and, if need be, to reproduce it with understanding. Whilst we have this very desirable treatment of theoretical matters, the practical side of the subject is no less satisfactorily dealt with. In small compass, an immense amount of well-selected and clearly-put information is conveyed; for example, in the two pages which are devoted to the electric arc, the essential features of the phenomenon are given with a precision and conciseness infrequent in physical text-books. The chapter on electroanalysis affords a similar instance of happy exposition. Throughout the book, and especially where matters of recent controversy are under discussion, there is manifested a temperateness of language and sobriety of judgment which cannot be too highly commended.

The first two chapters of the volume give an account of fundamental physical and chemical conceptions, and of the older electrochemical theories. The next five chapters are chiefly concerned with osmotic pressure and the thermodynamical deductions from it, the general conditions of equilibrium, and the velocity of chemical actions. Chapters viii.-xii. are devoted to electrolytic dissociation and the deductions to be drawn from that theory. In chapters xiii.-xv., electromotive force is dealt with; and in the last two chapters are taken up the practical subjects of electroanalysis and the development of heat by the electric current.

The present translation has been made from the German edition, which is a somewhat expanded form of the Swedish original. The English version is well done, and we have to thank Dr. McCrae in addition for an excellent index and a very useful appendix of references. J. W.

A Manual of Indian Timbers. By T. S. Gamble, M.A., C.I.E., F.R.S., F.L.S. Pp. xxiii + 856; illustrated by photographs of wood sections. New (second) and revised edition. (London: Sampson Low, Marston and Co., Ltd., 1902.)

THE first edition of this important work appeared in 1881, giving the results of investigations made by Sir Dietrich Brandis and his assistants, Messrs. Gamble and Smythies. It was edited by Mr. Gamble, and it contained descriptions of 906 species of Indian timbers. The new edition has been entirely prepared by Mr. Gamble; it deals with about 1450 species, including all, or nearly all, really important timber-woods. The total number of species of trees, shrubs and climbers found in India and Ceylon is estimated to amount to about 5000,

so that there is room for further extension should hereafter a third edition become necessary.

The book is a very storehouse of information, and this will be realised if we state that for every important, and most other, species the information extends to :—

(1) Size and appearance of tree ; whether evergreen or deciduous ; mode of branching.

(2) Description of bark.

(3) Description of wood, both sapwood and heartwood, with its colour, hardness, grain, scent, the character of the annual rings, pores, medullary rays, &c.

(4) Distribution, rate of growth, &c., of the trees.

(5) Weight per cubic foot of timber; transverse strength.

(6) Sylvicultural aspect of the species.

(7) Insects injurious to the tree ; and other points of interest.

An admirable addition in this new edition are 96 photographs (enlarged $3\frac{1}{3}$ times) of timbers; these were prepared at the forest branch of Coopers Hill College from a large collection of negatives, started by Mr. C. A. Barber, now Superintendent of Botanical Survey, South India, when instructor in botany at the college.

Space is not available to enter upon a detailed account of the contents of this monumental book, but attention may be drawn to what, in our opinion, constitutes one or two shortcomings India has been divided into eight regions for the purpose of indicating the main classes of forest growth, but, unfortunately, the author decided not to give a map showing these, because he thinks a map, to be of any real use, would have to be of a rather unwieldy size and would be difficult to insert. With this view we disagree. Considering that India comprises an area of about $1\frac{1}{2}$ million square miles, a map indicating the above-mentioned eight regions would have been exceedingly useful. On this map, the exceedingly varying rainfall, which practically governs the distribution of the forests, might have been shown in a summary manner, or it might have been given on a separate map. The size of these maps need not have been larger than that of a double page, and they could have been inserted with the greatest ease. Nor does the binding seem to us sufficiently strong in the case of a book of nearly 900 pages, which will be taken about in camp by those who are most in need of the information given in it.

Apart from these minor matters, we may confidently say that the book is of immense importance in the economic development of the resources of the Indian forests, and it should be, as the old edition has been, the constant companion of every Indian forest officer, and of others who take an interest in the subject.

We heartily congratulate the author on the successful completion of this new edition.

Phyllobiologie, nebst Übersicht der biologischen Blatttypen von ein und sechzig Siphonogamenfamilien. Von Prof. Dr. A. Hansgirg. Pp. xiv + 486; mit 40 Abbild. im Text. (Leipzig: Gebr. Borntraeger, 1903.) Price 10 marks.

Prof. Hansgirg has written a big book that may have its use as a work of reference, but it certainly cannot be described as possessing an interest commensurate with its bulk. Long periods often extend over more than half a page, and are quite unbroken save for the commas delimiting the innumerable subordinate clauses that serve to qualify or define the main idea. An effort is made to classify the various kinds of leaves into different biological groups, and then the various types of leaves met with in different natural orders are successively indicated. As an example of the method, the case of the ericoid leaf-form may be cited. The type is briefly described, and then follows a *list* of plants, extending over eight pages, that are grouped under it.

In the concluding chapters a short summary of the main results is given, and their general bearing upon variation and evolution is briefly discussed. It is pointed out that closely related species often are found to possess very different kinds of leaves, and this fact is related to the combined interaction of the environment and the inherent constitution of the organism. The author seems to suggest that it may be possible to construct a sort of phylogeny of these adaptations, and so to refer them back to a primitive leaf-form. But it may be doubted whether such speculation can really advance matters very much. We know too little of the former climates and of the extent of adaptive variation these were able to evoke, and the more profitable line of inquiry would seem to be that which is directed towards an experimental treatment of plants at the present day. This line of investigation has already proved itself to be fruitful, and there is reason to think that it is by no means as yet worked out.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities. By Charles G. Barrett, F.E.S. Vol. viii. Heterocera, Geometrina. Pp. 431. (London: Lovell Reeve and Co., Ltd., 1902.)

The eighth volume of Mr. Barrett's great work on the British Lepidoptera deals with upwards of 120 species, referred to the families Acidaliidæ and Larentidæ, the latter being extended to include the genus Eubolia and its allies, sometimes treated as a distinct family. Consequently, this volume is devoted to the interesting groups of slender-bodied, broad-winged moths known as "Waves," from their white or yellow wings, crossed by waved dark lines; and "Carpets," from their intricate and festooned patterns. The great genus Eupithecia, which includes the smaller and darker moths called "Pugs" by collectors, which belongs, like the "Carpets," to the Larentidæ, stands over until the next volume.

The scope of Mr. Barrett's work is indicated by the title-page, and the workmanship, of which we have spoken fully in our notices of previous volumes, remains on the same level of uniform excellence. The present range of each species is given very fully, and this, though a subordinate point, is very useful, not at the present moment, but as supplying accurate data for a future comparison of the range of the same species in the British Islands at different periods. The works of Stephens, Stainton, Meyrick, Barrett, and of subsequent writers will enable this to be done with approximate accuracy whenever it seems desirable to make such a comparison, which will be more useful, perhaps, in the case of moths than butterflies, for the history of British butterflies, unfortunately, is one of increasing restriction of range and increasing rarity, ending, but too often, in utter extinction. Nevertheless, in the "Additions and Corrections" (p. 428), we read of the capture of a specimen of *Polyommatus Dorylas*, Hübn., near Dover, in 1902, a butterfly which, though figured as British by Lewin a century ago, has never been formally admitted into our lists, single specimens only being met with on the south coast of England, at intervals of many years.

We should mention that there is a large-paper edition of this work, illustrated by good coloured plates of all the species in their various stages; but at the moment of writing this is not before us.

The Design of Simple Roof Trusses in Wood and Steel. By M. A. Howe, C.E. Pp. viii + 129. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 2.00 dollars.

THIS little book is intended to serve the purposes of students in mechanical and electrical engineering, who desire to have some knowledge of the methods of design adopted in civil engineering, and hence the examples chosen are two very simple forms of roof trusses.

The first two chapters give a brief outline of the general principles on which are based the graphical determination of the stresses in the various parts of a roof truss; then follows a carefully written chapter on the strength of the various materials used in roof work in tension, compression, cross-bending and shear. The author then works out in complete detail the design of a 60-feet-span wooden roof truss, and of a 60-feet-span steel roof truss—one particularly good feature of this part of the book is the extreme care which has been shown in the explanation of the design of the various joints needed in such roof trusses.

There are three well-drawn plates to illustrate these two roofs and a series of seventeen tables, including a most useful set giving moments of inertia, radii of gyration, &c., for various rolled sections commonly used in the struts of roof trusses.

We can recommend the book as one likely to be of much use to both teacher and student in classes for the study of civil engineering design.

Stereotomy. By A. W. French, C.E., and H. C. Ives, C.E. Pp. iv + 115. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 10*s*. 6*d*.

THIS is another text-book for the student in civil engineering, and treats of masonry work, mainly in arches and domes.

The two first chapters give a brief account of the various stones used for building purposes, and their physical characteristics, and of the tools used in quarrying and cutting the blocks into their finished forms. The third chapter treats of plane-sided structures, such as bridge piers and abutments, with several practical examples illustrated by plates. Chapter iv. deals with structures containing developable surfaces, and includes a detailed treatment of the masonry arch; the geometry of the arch is explained, and the preparation of the working drawings for use by the stone mason, and also the methods employed in dressing the stones. The oblique or skew arch, difficult both in its geometry and in its constructional details, is worked out in a separate chapter, with several fine illustrative plates.

As the twenty-two plates which illustrate the text are drawn from actual masonry structures, such as the Worcester City Hall, the Trenton railway bridge, &c., they will prove extremely useful to the student, more especially as there are few recent text-books which deal at all fully with this branch of the art of the civil engineer.

Round the Horn before the Mast. By A. Basil Lubbock. Pp. x + 375. (London: John Murray, 1902.) Price 8*s*. net.

THESE experiences of a public school man, who at San Francisco turned himself into an ordinary seaman and "signed on for two pounds a month for a passage round the Horn, calling at Queenstown for orders, either for the British Isles or Continent," will interest most boys. Probably few adult readers will get to the end of the volume, but Mr. Lubbock can congratulate himself that most boys will read all he has written and pronounce it "good."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radio-activity of Ordinary Materials.

I SHOULD like to say a few words in answer to Prof. Armstrong's letter, in which he suggests that the effects observed by Prof. McClennam and myself are not due to radio-activity, but to chemical changes at the surface of the substances experimented upon. In speaking of the radio-activity of ordinary materials, I mean that they show effects differing only in degree from those exhibited by uranium and radium. These effects, as observed experimentally, are as follows:—

(1) There is a leakage of electricity from a charged body in the neighbourhood. This leakage is proportional to the E.M.F. for small E.M.F.'s, but for large ones independent of it.

(2) The effect varies with the pressure of the air, being for small pressures proportional to the pressure, and for large pressures independent of it, when the E.M.F. is sufficient.

(3) The rate of leak is the same for positive electricity as for negative.

(4) The rate of leak does not depend on the temperature.

(5) When other gases are substituted for air, the leak is nearly proportional to the density of the gas, except in the case of hydrogen, which gives about one-eighth the effect that air does.

In every one of these points there is exact agreement of behaviour between uranium and the ordinary materials. On the other hand, I am not aware that any difference has been brought to light, except as to the magnitude of the effects. Until such a difference should appear, I think we may fairly, and without dogmatism, apply the maxim that similar effects are due to similar causes. In other words, we may conclude that the other substances, like uranium, are radio-active.

R. J. STRUTT.

A Case of Pseudo-mimicry.

IN Campbell Island, south of New Zealand, the breeze-fly (*Helophilus campbellicus*), one of the Syrphidæ, so closely resembles a blow-fly (*Calliphora eudypti*) that when, in 1901, I captured a specimen of the first, which is rare, I thought it was the blow-fly, which is common; and it was not until I was transferring my captures to boxes that I found out my mistake.

C. eudypti has the abdomen metallic bronzy green, with a dark thorax, and black and tawny legs. *H. campbellicus* has also a metallic bronzy green abdomen, a dark thorax, and black and tawny legs. There is a difference in the stripes on the thorax, but they are obscure. In size the two insects are the same.

Now in any other locality this resemblance could be put down to mimicry. The blow-fly is common and offensive. The breeze-fly is rare and feeds on flowers. Everything favours this explanation except that in Campbell Island there are no insect-eating birds and no lizards, and consequently mimicry would be useless. Evidently, in this case, the resemblance is only a coincidence and has no meaning.

F. W. HUTTON.

Museum, Christchurch, N.Z., January.

ACCIDENTAL resemblances between insects are to be expected. The immense number of species and the necessary limitation in the variety of colours and patterns must lead to coincidences, as, I believe, was first pointed out by Mr. F. E. Beddard in his book on "Animal Coloration." The coincidences would, of course, be relatively more numerous when the patterns are simple. Accidental resemblances being independent of locality and of an origin based upon utility, it follows that *a very small proportion* of the total number of cases are to be expected to occur under conditions which are the characteristic concomitants of true mimetic resemblance.

With regard to Captain Hutton's special instance, however, there appear to be certain points which require consideration before accepting the conclusion that the resemblance is merely a coincidence:—(1) The possible coexistence of the two species in other localities where the resemblance has a meaning; (2) the possible change of conditions in the struggle for life in the locality itself; (3) our possibly imperfect knowledge of the struggle which is waged there now. Furthermore, a careful comparison between both forms and their respective allies—a comparison which takes account of geographical distribution as well as of superficial appearance—would certainly throw light upon the origin of their present appearance, and probably upon the meaning of the likeness which they bear to each other.

When questions such as these have been answered so as to leave no doubt about the accidental nature of the resemblance, it will be necessary to ascertain whether the "offensive" qualities of the blow-fly are any defence against insect-eating animals. If they are not, the resemblance would still lack an essential characteristic of true mimetic likeness. E. B. POULTON.

Oxford, March 6.

Area of Triangle in Terms of Sides.

As the changes which are being introduced, in accordance with Prof. Perry's suggestions, into geometrical teaching are giving a stimulus to the production of text-books of practical geometry and mensuration, the present is a good time to point out a more direct proof of the formula for the area of a triangle in terms of its sides than that usually given.

From the centres of the inscribed and one escribed circle, drop perpendiculars on the sides or their productions. Also join these centres to the corners A, B, C.

We have then, by similar triangles,

$$\frac{s-c}{r_a}=\frac{r}{s-b}, \text{ whence } rr_a=(s-b)(s-c).$$

The area of the triangle ABC is equal to rs, and also to $r_a(s-a)$; and therefore to $\sqrt{\{rr_a s(s-a)\}}$ that is to

$$\sqrt{\{s(s-a)(s-b)(s-c)\}}.$$

11 Leopold Road, Ealing. J. D. EVERETT.

LEONARDO DA VINCI AS A HYDRAULIC ENGINEER.

IN the December number of the *Bulletin* of the French Society for the Encouragement of National Industry[1] is an article by M. M. A. Ronna on Leonardo da Vinci, in his capacity of hydraulic engineer; with extracts from his works and several reproductions of sketches of the numerous mechanical contrivances he invented for saving labour, for measuring the discharge of water, for lock gates and other hydraulic appliances.

Leonardo da Vinci, who was born in Italy in 1452, has generally been recognised as one of the most illustrious painters of the world, being classed as an artist with Raphael and Michael Angelo. His most celebrated work was the fresco representing the Last Supper, which was painted in his middle life. He was also the author of a treatise on painting, which was published in several different languages. His gifts as sculptor, musician and poet are less known; and it may be a surprise to many to be told that Leonardo da Vinci was by profession an engineer, engaged principally in designing and carrying out works for the construction of canals, the drainage and reclamation of marshes, and similar work in Italy; and in his later life in France, to which country he was invited by Francis I. to advise as to hydraulic works there. He held the appointment of engineer and director of works in Lombardy and Tuscany, and also acted as chief engineer in the army of the Pope. In addition to his executive work, he thoroughly investigated the laws relating to the movement of water and hydraulics generally, and anticipated many of the theories for which credit is

FIG. 1.

generally given to men of science who lived very many years later. He appears to have grasped a knowledge of the action of gravity more especially in its relation to the movement of liquids, and states his inability

FIG. 2.

to furnish to the human mind a scientific proof of its existence, as he considered that, in common with magnetism and other phenomena, it was one of the secrets of Nature. Hallam, in his introduction to the

[1] *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, December, 1902. (Paris: Published by the Society.)

"Literature of Europe," referring to Leonardo, says the discoveries which made the names of Galileo, Kepler, Castelli and others famous, the system of Copernicus, the very theories of recent geologists, were anticipated by da Vinci within the compass of a few pages, not perhaps in the most precise language, or in the most conclusive reasoning, but so as to strike in with something like the awe of preternatural knowledge.

Leonardo da Vinci in his writings deals with and explains the formation of rain drops, the capillary action of liquids, the equal pressure of water in closed vessels, anticipating the application of this principle as carried out nearly three centuries later by Bramah in his hydraulic press. The theory of the motion of waves in water is fully dealt with. The illustration he gives of a field of corn under the influence of the wind when a wave motion traverses the field without the stalks moving, to show the action of the water in similar circumstances, has been often used since, and was adopted by Scott Russell in his report to the British Association on waves in 1836.

Leonardo da Vinci appears to have devoted much attention to the use of mechanical appliances for saving labour in the excavation and removal of earth in the various canals that he was engaged in constructing. He was the first engineer to adopt the use of weirs and locks for overcoming the varying levels of the country through which his canals were carried. A sketch of a pair of lock-gates (Fig. 1), as used on the canal from Ticino to Milan, called the "Naviglio Grande," as given in his "Codice Atlantico," is here reproduced. Gates of almost similar design may still be seen on many of the older canals of this country, where locks were not made use of until 1566. As specimens of the sketches of mechanical contrivances given in his treatise, the illustration of machinery for raising heavy weights (Fig. 2) bears a strong resemblance to appliances to be found amongst contractors' plant of the present day.

The theories set out by Leonardo da Vinci, and his laws for regulating the flow of water in open channels as derived from his own practice and observation, for ascertaining the velocity of discharge due to the balance of forces established between gravity and friction, as to the effect of the junction of two waterways, and the velocity of movement of water as affected by the form of the channel and the depth of the water, anticipated by fully a century the works of Gugliemini, of Paul Frisi and Castelli, to whom, generally, has been given the credit of first determining the problems of hydrology.

THE PHYSIOLOGICAL LABORATORY OF THE UNIVERSITY OF LONDON.

IT was the fear of some of those most interested in the renaissance of the University of London that the good effects of the transfer from Burlington House to the Imperial Institute would not become apparent until many years had elapsed. As scientific research is more and more taking its proper place as the highest duty that a university can perform, it is very gratifying to learn that the University of London has seized a favourable opportunity, and utilised its enlarged premises to this end. Even though this laudable endeavour must be at present regarded in the light of a preliminary experiment not yet included in any authorised programme, the physiological laboratory tentatively initiated by the University appears to be admirably adapted for the purposes to which it is applied, namely, for lectures on advanced physiology and for physiological research. But its chief value is as a concrete object-lesson of what the well-wishers of education in this country desire to see promoted by the University of London, and we are inclined to add, with bated breath, fed from the national exchequer. A municipal body may be expected to realise the importance of technical science, and to pay for its establishment. But it requires outlook towards a wider horizon to realise that apparently useless knowledge is in reality knowledge of which the reward is to be received by future generations.

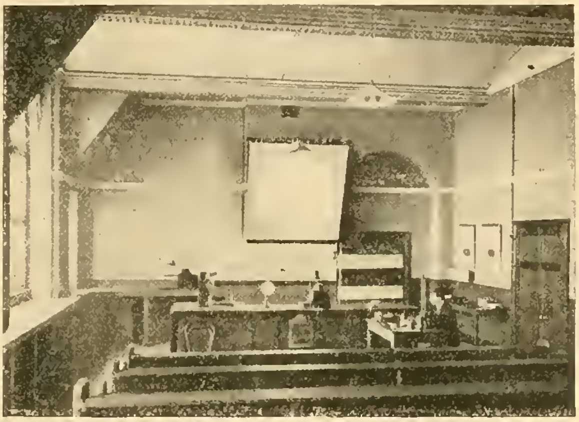


FIG. 1.—Room No. 17 (The Lecture Room).

The habitation of this infant laboratory at present comprises the top floor of one side of the main building. A long corridor extends throughout its whole length, and the various rooms open from this right and left. The first, counting from the entrance, is the workshop, where a 1 h.p. dynamo provides power for the various tools used in constructing the smaller apparatus required from time to time. Next is the lecture theatre, with seats for eighty students. Arranged for lectures in advanced physiology, this accommodation has so far proved sufficient; the average attendance has been about thirty, and as no attempt has been made to give merely popular demonstrations, and as only students are invited who already possess some knowledge of the subject, these numbers are very

FIG. 2.—Room No. 19 (General Laboratory).

encouraging. The rooms devoted to research are five in number. That next the lecture theatre, with furnaces and a fume chamber, is the chemical room, and contains in addition the apparatus used by the British Medical Chloroform Committee in its determinations. No. 19, with two dark rooms attached, is the general laboratory. This is the largest room on the landing; the centre is used for general purposes and the far end is half-shaded, and serves for galvanometers with the attendant apparatus. Two complete tables are furnished, one with a dark room for photography, and both are at present occupied.

On the opposite side of the long corridor are rooms 20A, 20B, and 21. The two former are fitted up for experiments on the circulation. No. 21 is the private room of the lecturer in charge; it is also used for research in experimental psychology; another galvanometer with resistances, &c., for the lecturer's use stands at one side. Two small rooms are available here, either as dark rooms or for other purposes.

The total laboratory accommodation for research is arranged for a maximum number of ten workers, it being considered that this was what might be reasonably expected, as quality is infinitely more important in work of this kind than quantity. The present workers are seven in number.

Several papers communicated to the Royal Society and other learned bodies testify to the activity of the place, and we shall expect, with some curiosity, a report on its first year of work. The University authorised the occupation of the laboratory in February last, and there does not appear to have been much time lost in getting to work.

PROF. WILLIAM HARKNESS.

By the lamented death of Prof. Harkness, America loses one of the most devoted of her scientific workers, and the staff of the Washington Observatory one who has laboured strenuously to bring its reputation to the high level it at present enjoys. It is true that his official connection with that institution has recently ceased, but his abiding interest in its future welfare did not end with his enforced retirement. In the few words of farewell in which he announced his approaching resignation, he still evidenced his interest in the Observatory he had served so long and so faithfully, and in a spirit of true loyalty to practical astronomical science, he indicated the direction in which he considered the equipment deficient and the lines on which further extension should proceed.

In 1862 we first find his name mentioned as an assistant, working with the mural circle and prime vertical instrument at a time when Prof. Hubbard, whose name recalls another and a different sphere of scientific activity, had the control of those instruments, and determined the direction in which they should be employed. In the following year Prof. Hubbard died, and the new assistant was elected to the professoriate, but remained in charge of the same apparatus. From this time onward, the history of Prof. Harkness is written in the *Annals* of the Observatory, and in its activity and its development he found ample occupation, as in its increasing reputation and influence he found his reward. There is no need to go over in detail the various works in which he was engaged, whether as an accurate or painstaking observer, or as one singularly capable in the management and arrangement of large pieces of laborious, and perhaps uninteresting, work. Let his work on the reduction of the observations of Gilliss' zones, or his perhaps unthankful task in reducing the observations of the transits of Venus in 1874 and 1882 speak for his patience and energy. Just as little need we refer to his various determinations of differences of longitude, or of his participation in the observations of solar eclipses and their subsequent discussion; it is sufficient to say that no astronomical inquiry, that occasionally in the course of long years falls to the lot of an observatory assistant of the highest class, passed without his contribution to its success, or his suggestion for its improvement. Finally, we find him occupying the position of astronomical director of the Observatory and superintendent of the Nautical Almanac, a twofold task which must have taxed his activity, but it cannot be said that he was found wanting in either capacity.

Perhaps he will be best remembered, as he is best known, by his work on the "Solar Parallax and its Related Constants," though we should doubt if he would consider it as his best contribution to astronomical inquiry. In it he undertook the difficult, perhaps impossible, task, to assign a relative degree of accuracy to observations differing in character, in principle and in design, and to deduce from the multifarious evidence a precise value of the solar parallax, in which each of the different processes contributes its just share to the final result. But the extent and completeness of the inquiry constitute it a valuable historical record. His theoretical writings and his mechanical ethos each call for a word of remark. As evidence of the former, we may refer to his paper on the "Colour Correction of Achromatic Telescopes," and of the latter to the share he took in the transfer of the old observatory to its new site, to his remodelling of instruments, and, in particular, to his invention of the spherometer-calliper, which, we believe, was used with success in the testing of the instruments employed in the transit of Venus expeditions. In him astronomy loses one who has spent himself without stint in her service, and his colleagues, to whom we offer our respectful sympathy, a sincere friend and an able director.

W. E. P.

NOTES.

THE council of the British Association has unanimously nominated the Right Hon. Arthur James Balfour, F.R.S., to the office of president for the Cambridge meeting in 1904. It has also been agreed to recommend to the Association the acceptance of the invitation to South Africa for the year 1905.

MAJOR P. A. MACMAHON, F.R.S., has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

THE death is announced of M. Gaston Paris, distinguished by his critical contributions to philological science. M. Gaston Paris was a member of the French Academy, and head of the Collège de France.

THE death is announced of Dr. Hénocque, assistant director of the laboratory of biological physics in the Collège de France.

THE officers elected by the French Physical Society for the current year are as follows:—Vice-president, Prof. D'Arsonval; secretary, M. H. Abraham; vice-secretary, Prof. Jules Lemoine; treasurer, M. de la Touanne. The president (M. H. Poincaré) announces that the Society has received an anonymous donation of 2000 francs.

A NEW series of the *Journal des Savants* commences with the present year. It will in future be under the control of

an editorial committee, consisting of a representative of the Académie Française; M. Léopold Delisle, representing the Académie des Inscriptions et Belles Lettres; M. Berthelot, representing the Académie des Sciences; M. Jules Guiffrey, representing the Académie des Beaux Arts; and M. R. Dareste, representing the Académie des Sciences Morales et Politiques. M. Henri Dehérain is secretary of the committee.

MOUNT VESUVIUS is reported to be in a state of eruption and to be ejecting scoriæ and incandescent masses which explode.

MR. T. H. HOLLAND has been appointed director of the Geological Survey of India, in succession to Mr. C. L. Griesbach, who has retired.

A SEVERE and prolonged earthquake is reported to have occurred in the island of Dominica on March 7. An earthquake shock has also been felt at Aquila, sixty miles north-east of Rome.

A REUTER'S despatch from Mexico announces another eruption of the volcano Colima on the morning of March 6, this being the most violent yet recorded. The eruption was accompanied by showers of ash, dense clouds darkened the sky, and there were deep subterranean roars. Shocks of earthquake were felt at intervals along the west coast. It is reported that ashes have fallen in great quantities at Uruapan, a hundred miles distant.

A REUTER'S message reports that earthquake shocks were felt in the Saxon district of Vogtland and the Erzgebirge on March 5 and March 6. At Graslitz, some twenty miles to the west of Karlsbad, the inhabitants left their houses and passed the night in the streets. The tremors were felt as far as Plauen, Reichenbach and Zwickau, situated within a radius of twenty-five to thirty miles to the north of Graslitz. At Unter-Sachsenberg, in the Zwickau district, the houses trembled for several seconds. Great excitement prevailed at Karlsbad and Asch, where shocks were also experienced, although they were of a less violent character.

ON March 4 Dr. M. W. Travers gave a lecture before the University College Chemical and Physical Society on "The Attainment of Low Temperatures." An account of the various methods of liquefying gases was given. The simplest case of all, where a gas such as sulphur dioxide can be liquefied by the application of pressure alone, was first experimentally shown. Those cases in which intense cold as well as pressure is needed were next considered; of the methods used in such cases the principle of adiabatic expansion as used by Olszewski to liquefy oxygen and hydrogen was explained and experimentally demonstrated. By this means, however, very little more than a mist of liquefied gas can be obtained. The regenerative cooling process first successfully applied by Hampson in England and Lindé in Germany was then described, and a brief account was given of its application to the liquefaction of hydrogen by the lecturer. Dr. Travers also described in detail his latest form of hydrogen liquefier, in which the regenerative cooling is practically perfect, and the escaping hydrogen is only one or two degrees below the air temperature. During the lecture the solidification of hydrogen was repeated, and a spectrum tube was filled with helium and neon by solidifying everything but helium and neon from a sample of air by means of liquid hydrogen.

IN December last several gentlemen engaged in various departments of scientific work in Newcastle-upon-Tyne met to consider the possibility of enabling local workers in science to meet together in a less formal manner than is possible at the ordinary meetings of the various scientific and technical societies, and resolved to establish a club "to serve as a social meeting place for men interested, professionally or otherwise, in scientific work." Such a club has now been established under the name of "The Northern Scientific Club"; a club room has been engaged, and informal meetings are held every Saturday evening. At the first annual meeting the Hon. C. A. Parsons, F.R.S., was elected president, Mr. F. T. Marshall chairman of committee, and Messrs. F. C. Garrett and T. Hanning hon. secretaries. Nothing but good can result from such a mingling of the professor and the works manager, and from the bringing into more friendly relationship men connected with different branches of science. The new club should become an important and useful institution in Newcastle.

THE Agricultural Organisation Society has arranged a conference on agricultural cooperation to be held at University College, Reading, on Saturday, March 21, under the presidency of the Lord Lieutenant of Berks, Mr. J. Herbert Benyon.

A MEETING in commemoration of the tercentenary of the reign of Queen Elizabeth will be held at the Royal Geographical Society on March 23. Addresses will be delivered by the president, Sir Clements Markham, K.C.B., Mr. Edmund Gosse (Raleigh), Mr. Julian Corbett (Drake), Prof. Silvanus P. Thompson, F.R.S. (William Gilbert and terrestrial magnetism), and others. There will also be an Elizabethan exhibition of portraits, globes, maps, atlases, instruments, navigation books and various relics.

A REUTER message from Brisbane, dated March 10, states that a disastrous storm has visited Townsville. The damage done by the storm is estimated at 200,000*l*. The town is practically wrecked.

THE Postmaster-General has appointed the following delegates to represent this country at the International Telegraph Conference to be held in London at the end of May:—Mr. J. C. Lamb, C.B., C.M.G., Mr. John Ardron, Mr. P. Benton, Mr. R. J. Mackay, and Mr. F. W. Home.

THE Post Office authorities have agreed to connect the Marconi wireless telegraph station at Poldhu, Cornwall, with the Post Office station at Falmouth. Though this will facilitate the transmission of ethergrams, it represents but a slight concession to the requirements of Mr. Marconi, inasmuch as the Marconi messages will, at Falmouth, have to take their turn with ordinary messages, which, in the case of commercial communications, might result in serious delay. The company has for some time past been urging the Department to grant it the same facilities which other cable companies enjoy—viz. that a cable may be handed in at any post office and transmitted by the Marconi system at an inclusive charge, and negotiations with this object are still proceeding.

THE use of wireless telegraphy for communication between lightships and lighthouses and the shore was referred to at the annual meeting of the Royal National Lifeboat Institution on March 5 by Lord Charles Beresford. Mr. Gerald Balfour, M.P., in his remarks upon the matter, said it naturally took time to deal with the question of the adoption of wireless telegraphy, owing to the fact of private and other interests being involved, but he assured the meeting that the question was receiving the careful attention of the Board of Trade, and he hoped it would not be long before such communication as that suggested by Lord Charles Beresford would be effected.

Speaking at the Chambers of Commerce conference on March 5, Mr. Marconi said wireless telegraphy had now, he thought, reached a stage in which it could be satisfactorily employed for communications between lightships, lighthouses and the shore. In England at present there is no lighthouse connected with the land by this system, but instances outside England where such communications have been established and have performed useful service can be quoted. In England the system was once tried between the East Goodwin lightship and the shore, and Mr. Marconi said he believed it was in the records of Trinity House that it worked satisfactorily. As to the cost, up to twenty or thirty miles, or even a greater distance, this would amount to from 300*l.* to 400*l.* Cables, he pointed out, cost at least 200*l.* per mile.

The New York Central Railway has, the *Westminster Gazette* announces, made arrangements with the American Deforrest Wireless Telegraph Company to instal its apparatus on the twenty-hour express from New York to Chicago. The installation is to be complete by April 1. It will be run for two months as an experiment, and if successful the plan will be permanently adopted.

By the joint efforts of the Middlesex Field Club and the Selborne Society, a committee has been formed with the view of organising a Home Counties Nature-Study Exhibition, to be held in London during the coming summer.

An international exhibition is to be held at Limoges from May to September this year. The exhibits will be comprised under the heads of education, the liberal arts, general mechanics, electricity, civil engineering, agriculture, horticulture, forestry, metallurgy, social economics, hygiene, special applications of medicated alcohol to motive power, lighting and warming, and other departments.

On Tuesday next, March 17, Sir Robert Ball will commence a course of three lectures at the Royal Institution on "Great Problems in Astronomy." The Friday evening discourse on March 20 will be delivered by Prof. E. A. Schafer, on the "Paths of Volition"; on March 27 by Prof. Herdman, on the "Pearl Fisheries of Ceylon"; and on April 3 by Lord Rayleigh, on "Drops and Surface Tension."

A letter received by Sir Alfred Jones, chairman of the Liverpool School of Tropical Medicine, from Prince d'Arenberg, president of the Suez Canal Company, informs him that the Campagnie du Canal de Suez is anxious to assist in the work that the Liverpool School is carrying on in West Africa, and has accordingly resolved to subscribe 50*l.* sterling to the school.

The officials of the Sanitary Department of the Egyptian Government, into whose hands the expenditure of the recent gift of 40,000*l.* entrusted to Lord Cromer and his successors in office by Sir Ernest Cassel for the relief of ophthalmia and eye diseases has virtually passed, have decided to employ it in establishing a "travelling dispensary" in the form of a tent, to suffice for all purposes of operation and treatment, and to work solely in the provinces.

In the House of Commons on March 4, in reply to a question as to the course the Government proposed to take on the expiration of the present Vaccination Act, and whether legislation would be proposed this Session to make revaccination generally compulsory, Mr. Balfour stated that it is proposed to renew the existing Act for this year, and to defer any further legislation on the subject to a future Session.

The council of the Zoological Society of London has just sold to an American purchaser the Society's African elephant "Jingo," we believe on account of periodical outbreaks of temper, which rendered him dangerous and practically unmanageable. "Jingo" was purchased by the Society in July, 1882, at which date he stood 4 feet 2 inches in height and weighed 788 lb. He was then believed to be about three or four years old. At the time of his departure he was considered to be the largest elephant ever kept in captivity.

It is reported by Reuter that at the Ministry of Foreign Affairs in St. Petersburg a Russian committee is being created for historical, archæological, linguistic and ethnographic research in Central and East Asia. The regulations applying to the committee allow all men of science without distinction of nationality to take part in the labours of the committee. The president and delegates of the foreign committee of the International Association for Research in north-east Asia will have the right to attend the sittings of the Russian committee at St. Petersburg.

The Viceroy has decided, it is announced in the *Pioneer Mail*, to devote the donation of 20,000*l.* from Mr. Henry Phipps to two objects, a laboratory for agricultural research, to be called the Phipps Laboratory, which will probably be situated at Dehra Dun, and the provision of a second institute in the south of India similar to that at Kasauli, which has already conferred such immense benefits upon Europeans and natives alike by saving them from hydrophobia. The donation will be devoted to the requisite buildings, while the site will in both cases be provided by Government, which will also in the first case contribute to and in the second undertake the cost of maintaining the institution.

The *Athenaeum* announces the death of Ritter von Scherzer, the Austrian explorer, who from 1852 to 1855, in company with the naturalist Moritz Wagner, carried out extensive scientific exploration in Northern and Central America. In 1857 he was appointed chief scientific adviser to the famous expedition of the *Novara*, the results of which were published in the volumes of the "Voyage of the Austrian Frigate *Novara* Round the World," which has appeared in many editions since its first issue in 1861-2, and has been translated into English.

The following countries took part in the international balloon ascents on the morning of January 9:—France, Germany, Austria, Spain, Russia and the United States (Blue Hill). At Itteville, the new balloon station established by M. Teisserenc de Bort, twenty-five miles south of Paris, the lowest temperature, $-65°.2$ C., was at a height of 10,650 metres, temperature on the ground $5°.1$; an inversion, $9°.2$, occurred at 520 metres. At Strassburg a temperature of $-63°.1$ was registered at 10,600 metres, temperature at starting $1°.5$; inversion $9°.5$ at 500 metres. At Berlin the minimum temperature was $-50°.0$ at 11,400 metres, temperature on the ground $5°.8$, inversion $6°.3$ at 537 metres. At Vienna the readings were: on the ground $1°.0$, $-10°.0$ at 4090 metres, $-60°.0$ at 10,230 metres. Ascents in manned balloons were made at Munich, Berlin, Vienna and Guadalajara. An area of high barometric pressure lay over the south-east of the Continent; the ascents from Itteville and Strassburg appear to have been made under the influence of a depression lying to the westward.

A Blue-book has been issued containing the report of the Departmental Committee appointed to prepare a draft of the regulations to be made in pursuance of Section vii. of the Cremation Act, 1902. The objection which has

always been urged against cremation is that it might render the detection of crime impossible, as all evidence is necessarily destroyed by the process. To obviate this as far as possible, it is recommended that no cremation should be allowed to take place unless the cause of death can be definitely certified by the medical attendant, who is required to fill up an exhaustive certificate, which has to be submitted to, and must be approved by, a medical referee, unless an autopsy has been performed by an expert pathologist appointed for the purpose, or an inquest has been held.

THE applications of electricity in the treatment of disease are now being carefully studied, and almost every hospital has its X-ray department. Introduced originally for diagnostic and localising purposes, Röntgen rays have been found to possess properties which may in the future revolutionise the treatment of certain diseases. Carelessly applied, the rays may set up considerable inflammation of the skin exposed to their action, while lupus and malignant growths may be considerably benefited, or even be cured, by a number of exposures to these remarkable emanations. The rays seem to possess a selective action, destroying diseased tissues and bringing about reparative action, but leaving the healthy ones untouched. In cases of cancer hopeful results have been obtained; the treatment is painless, and it seems to relieve pain and to inhibit the progress of the disease. The mode of action of Röntgen rays is doubtful; by some it is supposed to be a bactericidal one, but more probably an inflammatory reaction is set up leading to phagocytosis and leucocytosis, whereby the wandering "scavenger" cells of the body accumulate, attack and destroy the morbid tissues.

A PAMPHLET has been received urging the adoption of Mr. J. Jackson's "System of Upright Penmanship." There can be no doubt that sloped writing necessitates a strained and asymmetrical posture, and has contributed to the production of countless cases of lateral curvature of the spine and of eye-strain, while upright writing is compatible with a natural and healthy posture. This fact alone constitutes a sufficient, and, indeed, urgent, reason for the teaching in all schools of upright in place of the old-fashioned sloped writing. But it seems that some of the advocates of upright writing claim as one of its principal advantages the fact that it can be easily executed with the left hand. They propose to form an association to promote the teaching of upright writing with both hands, believing that the child taught to write equally well with both hands will easily acquire left-handed skill in all other manipulations. This belief is probably well founded, but there are at present no sufficient grounds for the assumption that a child's mental development will be aided by the training of his left equally with his right hand. The balance of probability seems to be against it. It is further proposed to teach children to write different matter simultaneously with the two hands, a feat which appears to have been accomplished in one or two instances. If this proposal should be carried into practice the results should be of great interest to psychologists, but the process may be prejudicial to the development of strong and sane personalities by the subjects of the experiment.

TWO "meters" for testing the penetrating power of Röntgen ray tubes have been described by Dr. B. Walter in the *Fortschritte auf dem Gebiete der Röntgenstrahlen*.

PROF. B. SRESNEWSKY sends us some interesting geometrical constructions for the curvature of an air current in the presence of a vortex or cyclone, published in the *Bulletin* of the St. Petersburg Academy.

IN the *Transactions* of the Scotch Institution of Engineers and Shipbuilders, Mr. C. A. Matthey investigates the effect of the inertia of the connecting rod in communicating vibration to an engine, and discusses the possibility of so balancing the engine as to remove the vibration entirely.

IN connection with an epidemic disease discovered among the eels of the ponds at Orbetello, a new bacillus has been discovered by Dr. F. Inghilleri, whose investigations are published in the *Atti dei Lincei*. The disease in question is known as the "red plague," and the author considers it undesirable that eels so attacked should be used for food.

THE second part of M. Lucien Poincaré's annual review of progress in physics is contained in the *Revue générale des Sciences* for January 30. It deals with optics; magnetism and electricity; mechanics, including acoustics, elasticity and gravitation; thermodynamics, including the phase law, and low-temperature researches.

PROF. LUSSANA AND DR. CARNAZZI discuss in the *Nuovo Cimento* the effect of interposing a solid dielectric body on the length of the electric spark-discharge in air, and in particular the remarkable fact that, by placing the body close to the anode, the length of the spark may be considerably increased.

PROFS. LUMMER AND PRINGSHEIM propose in the *Berichte* of the German Physical Society a scale of temperature based on the theory of radiation which possesses many of the advantages of the absolute scale, but has the further advantage of being better adapted to the practical measurement of high temperatures.

IN connection with the calculation of the self-induction of a ring of rectangular section, Prof. Garbasso (Turin) has communicated to the *Nuovo Cimento* a demonstration that the assumption that the current is uniformly distributed across the section of the ring leads only to an error of the order of 5 per cent.

PROF. AUGUSTO RIGHI has communicated to the Bologna Academy (1902) some researches on the acoustical phenomena presented by the discharges of condensers. The sounds were obtained when the charge took place in a vacuum tube or through a flame, and the phenomena presented several points of difference from the effects observed by Duddell in the case of the electric arc.

FROM Signor Riccò's report in the *Atti dei Lincei*, we gather that the work connected with the photographic survey of the heavens is making substantial progress at the Observatory of Catania. During the year 533 photographs have been taken, and 31,200 measurements of stars have been made on 170 plates. In addition, the catalogue of stars of reference has been continued, and a number of redeterminations have been made and referred to the year 1900.

FROM a generalisation of Carnot's cycle, Mr. Sanford A. Moss, writing in the *Physical Review*, gives a proof that in a gas engine where the working substance may be regarded as a perfect gas, the efficiency is the same as for a Carnot engine, with the same range of compression temperatures.

SOME observations on the heat produced when powders are wetted have been published in the *Atti* of the Venetian Institution by Messrs. M. Bellati and L. Finazzi. The results, so far as they concern the influence of the size of the grains, differ from those of Linebarger. The authors further find that the quantities of heat produced by the addition of equal quantities of water decrease as more water is added.

Some observations on seiches and their relation to sea waves are given by Messrs. S. Nakamura, Y. Yoshida and H. Nagaoka in No. 15 of the Tokio Physico-mathematical *Reports*. Investigations were begun in 1901 on the seiches of Lakes Biwa and Hakone, and this year the instrument—a portable tide gauge described by Mr. Nakamura—was carried to the bay of Osaka. Mr. Nagaoka finds that seiches in lakes and the destructive sea waves observed on the coast of Japan are similar from the hydrodynamical point of view, and considers that the latter waves may be predicted, resulting in saving of life.

It is proposed to publish an index volume of the three first series of the *Journal de Physique*, including an analytical subject-index and an index of authors' names. The volume will be drawn up by MM. E. Bouty and B. Brunhes, with the collaboration of MM. Bénard, Carré, Couette, Lamotte, Marchis, Maurain, Roy and Sandoz.

Prof. Ernest Lebau has published a short note on the manuscript of a course of lectures delivered at the Collège Royal by Prof. J. N. Delisle on the geometry of the celestial sphere. The manuscript, which he calls manuscript D, was obtained from a dealer in old books, and is a quarto volume of 460 pages, written neatly in the handwriting of a good copyist of the eighteenth century; and from references to the prediction of a transit of Mercury, as well as the documents of the college, its date has been fixed as 1719. It has been presented to the library of the Paris Observatory.

A very interesting essay on Mendel's law of heredity, by Mr. W. E. Castle, appears in the January issue of the *Proceedings* of the American Academy.

In *Annotationes Zool. Japonensis*, Mr. I. Ikeda records the occurrence in Japanese waters of an Australian species of the aberrant annelid-like genus Phoronis.

The feature in the *Entomologist's Monthly Magazine* for March is the record of two additions to the British fauna. The first is *Kermes quercus*, a continental scale-insect, of which colonies were taken at Wimbledon and in Sherwood Forest; while the second is the beetle *Œdemera virescens*, of which examples were obtained some years ago in Norfolk, although not at the time identified with the common continental form.

The osteology and affinities of American Cretaceous and Eocene birds are discussed by Mr. F. A. Lucas in No. 1320 of the *Proceedings* of the U.S. National Museum. Marsh's *Hesperornis gracilis* is assigned to the new genus Hargeria.

To *Naturwissenschaftliche Wochenschrift* of February 15 and 22 Herr J. Meisenheimer contributes an interesting article on the method of estimating the degree of variation occurring in the individuals of a species, and the bearing of the results thus obtained on zoology.

The scientific *Bulletin* of the Royal Belgian Academy contains the report of an address, by Prof. E. van Beneden, on the reproduction of animals and the continuity of life. In another address M. Masius discourses on immunity to infection in man and the lower animals.

Remarks on the Atlantis problem forms the title of a paper by Dr. R. F. Scharff in the *Proceedings* of the Royal Irish Academy. The author is of opinion that until the Miocene the Azores and Madeira were connected with Portugal, and that a land-bridge extended from Morocco *viâ* the Canaries to South America. Further, it is urged that the Atlantic islands were again connected with Europe and Africa after man made his appearance.

The movements and reactions of fresh-water planarians, or flat-worms, form the subject of a long article by Dr. R. Pearl, of Michigan, in the February number of the *Quarterly Journal of Microscopical Science*. These movements are, in the main, what may be termed reflex; that is to say, they are dependent upon external impulses, and are not due to anything resembling volition. In another article Miss Sollas describes a new generic type of compound ascidian, from the Malay Peninsula, under the name of *Hypurgon skeati*.

In his notes on whaling and sealing during 1902, Mr. T. Southwell (*Zoologist* for February) records the capture of twelve Greenland whales by British vessels, most of which were full-grown individuals with "bone" from 10 to $10\frac{1}{2}$ feet in length. Whalebone now fetches as much as 2500*l*. per ton; the total value of the seals and whales taken by British vessels is estimated at 32,420*l*. In the same journal Mr. Frohawk adduces arguments to show that the common British bean-goose is *Anser arvensis*, and not, as generally supposed, *A. segetum*.

Two papers—one on mammals, by Mr. Miller, and the other on birds, by Mr. Richmond—in the *Proceedings* of the U.S. National Museum are devoted to specimens collected by Dr. Abbott on the coast of Sumatra and certain adjacent islets. It is considered that every distinguishable form of mammal from these islets is entitled to rank as a species—a course of procedure that will render mammaliology an almost impossible science. The most interesting mammal is a rat, referred by Mr. Miller to a new genus and species, under the name *Lenothrix canus*.

If only it be adequately carried out, an excellent scheme is announced in the February number of the *Field Naturalist's Quarterly*. This is a "symposium" in which the various members of the British fauna, commencing with the lowest, will be treated by different writers, mainly from the point of view of habits and adaptation to surroundings. The first of the series will commence in the next issue. It is perhaps not very hopeful to find, in the very next article, the marten called *Martes sylvatica*, which is certainly not its proper name.

In its report for 1902 the council of the Royal Zoological Society of Ireland has to record a most successful year, the list of donations having been probably more numerous and more valuable than on any previous occasion, and including a fine giraffe from the Sudan. The expenses connected with the carriage of the latter animal, and the outlay on the "Roberts' house" (which was opened during the year) have, however, seriously crippled the finances of the Society. Lion-breeding has, as usual, been successful, and attention is called to certain cubs of abnormal form which, it is thought, may be reversions to an extinct type. The report is illustrated with some excellent photographs.

A third edition of Mr. Andrew Pringle's "Practical Photo-Micrography" has been published by Messrs. Iliffe and Sons, Ltd., at 3*s*. 6*d*. net. The work has been largely rewritten, and important advances in photographic science and method have been utilised in the new edition.

Messrs. Macmillan and Co., Ltd., have published Mr. S. L. Loney's "Arithmetic for Schools" in two parts at 2*s*. 6*d*. each. The first part takes the subject as far as proportionate division, and includes contracted methods of multiplication and division; the second part completes the whole subject, concluding with upwards of five hundred miscellaneous examples.

AN exceptionally fine series of plates, reproduced from photographs, accompanies Dr. Tempest Anderson's paper on the recent volcanic eruptions in the West Indies, contained in the March issue of the *Geographical Journal*. The plates, together with Dr. Anderson's descriptions, constitute a concise and graphic story of the characteristics of the eruptions of Mont Pelée and the Soufrière of St. Vincent.

SEVERAL of the monthly magazines for March contain articles upon scientific subjects. Under the title "What shall we be?" Mr. Gustave Michaud discusses in the *Century* the question as to what will be the distinguishing characteristics of the coming race in America, and Prof. F. H. Giddings comments on the conclusions arrived at. Major-General Sir C. W. Wilson, K.C.B., contributes to the *Monthly Review* an account of the excavation of a Levitical city—Gezer. Dr. A. R. Wallace, F.R.S., in the *Fortnightly Review*, considers man's place in the universe as indicated by astronomy; and the general nature of his article may be gathered from a sentence near the end:—"The three startling facts—that we *are* in the centre of a cluster of suns, and that that cluster *is* situated not only precisely in the *plane* of the Galaxy, but also *centrally* in that plane—can hardly now be looked upon as chance coincidences without any significance in relation to the culminating fact that the planet so situated *has* developed humanity." Mr. W. A. Shenstone, F.R.S., writes in the *Cornhill* on the new chemistry, and Mr. Charles Richardson attempts in the *Westminster Review* to answer the question: Is natural science self-contradictory?

THE additions to the Zoological Society's Gardens during the past week include a Moustache Monkey (*Cercopithecus cephus*) from West Africa, a Crested Porcupine (*Hystrix cristata*) from South Africa, two Mexican Eared Owls (*Asio mexicanus*) from Mexico, two Westermann's Cassowaries (*Casuarius westermanni*) from New Guinea, two King Crabs (*Limulus polyphemus*) from North America, deposited.

OUR ASTRONOMICAL COLUMN.

ELEMENTS AND SEARCH-EPHEMERIS FOR COMET 1896 V (GIACOBINI).—In No. 3848 of the *Astronomische Nachrichten* Herr M. Ebell gives the following set of elements and ephemeris for this comet:—

Epoch 1896 *October* 5·5, *M.T. Berlin.*

$$\left.\begin{array}{l} M = 356^\circ\ 39'\ 7''\!\cdot\!4 \\ \omega = 140\ 31\ 51\cdot 1 \\ \Omega = 193\ 29\ 4 \\ i = 11\ 21\ 47\cdot 7 \end{array}\right\} 1900\cdot 0.$$

$$\mu = 533''\!\cdot\!805$$
$$\log a = 0\cdot 548416$$
$$T = 1896 \text{ October } 28\cdot 079$$
$$P = 6\cdot 647 \text{ years.}$$

Taking the period of 6·647 years as correct, the next perihelion passage should take place on June 22 or 23, and for this time the ephemeris which accompanies the elements is calculated.

Ephemeris 12*h*. *M.T. Berlin.*

1903.	a. h. m. s.	δ. ° ′	log r.	log. Δ	Brightness.
March 18	20 10 50	−10 32·9	0·2492	0·3313	0·63
,, 26	20 32 46	− 8 59·0	0·2381	0·3118	0·72
April 27	22 3 40	− 1 7·0	0·1975	0·2363	1·23
May 29	23 38 44	+ 7 53·7	0·1697	0·1733	1·88

The ephemeris is extended to November 29, and it indicates that the maximum brightness (2·7) will occur on August 25.

TRANSPARENCY OF COMET 1902 *b*.—In order to test the accuracy of the assertion that comets are perfectly transparent, Prof. O. C. Wendell, of Harvard College Observatory, made a series of observations, with the polarising photometer attached to the 15-inch equatorial, of the magnitudes of two faint stars when the comet 1902 *b* was passing before one of them on October 14.

On tabulating the results of the measurements, it was found that the mean difference of the magnitude interval of the two stars under normal conditions, and when the comet was passing before one of them, was only ± 0m.·02, thereby indicating that the absorption of light by the comet, if any, was insensible, and probably did not exceed one or two hundredths of a magnitude (*Astronomische Nachrichten*, No. 3848).

FEBRUARY METEORS.—In No. 329 of the *Observatory* Mr. Denning describes a bright meteor which he observed at 9h. 46m. on February 18, the apparent path being from $35°+44°$ to $19°+42°$.

Mr. Denning further remarks that this meteor appeared to come from a position near to the radiant point of a shower, the Aurigids, of which he has observed seven members, and of which the mean radiant point is about $75°+41°$, and he suggests that this particular stream is worthy of further consideration by meteor observers in order to determine more accurately its radiant point and the time of its maximum.

The duration of the shower is at present doubtful, but it certainly extends over the period February 7-23, and there is reason to believe that it is sustained during March and April.

PROPER MOTIONS OF STARS.—Vol. xvii. No. 1 (January) of the *Astrophysical Journal* contains a discussion, by Mr. Gavin J. Burns, of the proper motions of the 2641 stars given in Bossert's catalogue, which was published in the *Annales de l'Observatoire de Paris* in 1896.

After analysing the data Mr. Burns comes to the following conclusions:—(1) The stars increase in number as they decrease in size; (2) the stars thin out as their distances from the solar system increase; and, lastly, it appears that double stars generally have large proper motions, as is shown by the following comparison:—The average proper motion of 778 stars (from the first to the fifth magnitudes) as given in Dunkin's list is $0''\!\cdot\!15$, whilst the average proper motion of 54 double stars (from first to seventh magnitudes) as obtained from Struve's catalogue is $0''\!\cdot\!37$.

OBSERVATIONS OF JUPITER'S MARKINGS.—In the February *Bulletin de la Société Astronomique de France*, Senor José Comas Sola publishes the observations of Jupiter's markings which he has made since a previous publication of results in the September *Bulletin*.

These later observations fully confirm Senor Sola's previous statement that the trails of dark spots are at a level below that of the Great Red Spot, and that they form a current which flows beneath, and independent of, that spot.

This is plainly shown in the drawings which accompany the communication, for whereas in the drawing made on September 15 the trail of dark spots is seen adjacent to, and apparently emerging from behind, the Great Red Spot, on the later drawings it is seen that the distance between the two sets of phenomena is gradually increasing. The observations also indicate that the grey markings, which have been observed in the zone between the two dark bands in the southern temperate region, are in reality trails of dark material joining together the black spots which appear on the separate bands.

SOLAR PHENOMENA AND METEOROLOGY.—M. l'Abbé Loisier, of Thoisy-la-Berchére (Gold Coast), has just completed a daily record of the solar and meteorological phenomena for the past eleven years. The record contains daily drawings of the spots and faculæ on the sun's disc, and the ordinary daily meteorological data. Recognising the intimate relations which have been shown to exist between these two sets of phenomena, M. Loisier now proposes to investigate carefully this accumulation of material with a view of obtaining evidence for, or against, the suggested interrelations (*Bulletin de la Société Astronomique de France*, February).

THE GEOLOGICAL SURVEY OF THE UNITED STATES.

THE twenty-first annual report of the United States Geological Survey is divided into seven parts. The first and sixth parts were received some time ago and were noticed in NATURE for December 26, 1901.

PART II.—*General Geology, Economic Geology, Alaska.*

There is an elaborate report on the geology of Rico Mountains in south-west Colorado, by Messrs. Whitman Cross and A. C. Spencer. The structure is that of a dome-like uplift of sedimentary and igneous rocks, out of which a compact group of peaks, rising above 12,000 feet, have been carved. The igneous rocks appear partly in the form of laccoliths, but the elevation is not in large degree due to the intruded masses.

Devonian and Carboniferous rocks occur in the centre of the uplift, with faulted masses of Algonkian quartzites and schists. The great "Red beds" of Colorado succeed; they are partly Permo-Carboniferous, but in the upper portion Triassic fossils have been found. Jura-Trias and Cretaceous rocks also occur, and igneous intrusions are found at various horizons throughout the series. Some notable landslides are described, and it is mentioned that, in recent geological times, the central mountain region suffered severe shocks, which shattered the rocks at the surface and to unknown depths. In consequence, landslides have occurred when other conditions were favourable.

A study of the glacial sculpture of the Bighorn Mountains of Wyoming, by Mr. F. E. Matthes, leads to the consideration of cirques. It is maintained that they have not been due to scour, but rather to a natural quarrying process, essentially the product of a "bergschrund"—a crevasse or line of crevasses—which opens at a point between the moving névé and the quiescent névé, and is practically the upper limit of glacial motion. The author deals also with the effects of the occupation of valleys by névé, and introduces the term *nivation* to indicate its action as distinct from glaciation.

The Esmeralda formation in western Nevada, a freshwater-lake deposit, is described by Mr. H. W. Turner. It is of Middle Tertiary age, and contains fossil fishes and remains of ferns, fig, oak, willow, sumach, soap berry, and tree trunks 6 to 8 feet in diameter. It yields lignite, which may be of local value for stationary engines, house use, &c. The plants are described by Mr. F. H. Knowlton, and a new species of fossil fish, *Leuciscus turneri*, is named and figured by Mr. F. A. Lucas.

The origin of mineral veins at Boulder Hot Springs in Nevada is discussed by Mr. W. H. Weed. The veins have no special economic value, yielding but small quantities of gold, silver, copper, &c., but they are regarded as true mineral veins and as due to deposition from hot water. The Boulder Hot Springs are probably deep seated and connected with rhyolitic intrusions which formed the latest manifestation of volcanic activity in the region. It is believed that the gold is derived from granite into which the rhyolitic rocks were intruded.

The Eastern Choctaw coal-field is described by Messrs. J. A. Taff and G. I. Adams. It is of Upper Carboniferous age and forms part of the Indian territory, connecting the coal-fields of Arkansas with those of Kansas, Missouri and Iowa. It yields good bituminous coal. The Camden coal-field of south-western Arkansas is reported on by Mr. Taff. This is of Eocene age, and it yields a lignite which as a gas producer is said to be inferior only to the best cannel coals.

Reconnaissances in Alaska are reported on separately by Messrs. A. H. Brooks, O. Rohn and F. C. Shrader. These reports will be serviceable to future travellers and prospectors, as, in addition to geological and mineralogical notes, there are observations on the climate, timber, game, natives, &c. A useful list and explanation of Alaskan geographical names is contributed by Mr. Marcus Baker.

PART III.—*General Geology, Ore and Phosphate Deposits, Philippines.*

Mr. W. H. Hobbs contributes a memoir on the Newark (Triassic) system of the Pomperaug valley, Connecticut. The greater portions of the clastic rocks are reddish-brown sandstones and shales the constituents of which are mainly quartz, felspar and mica; they are, in fact, arkoses, composed of the débris of granite and gneiss. The associated igneous rocks are contemporaneous intrusions of lava, and attention is called to the production of secondary enlargement of quartz grains in a shale-conglomerate at its contact with an overlying sheet of basalt. The geological structure of the area is considered in detail. Vertical or nearly vertical joint-planes have developed in great numbers within the area, and an attempt is made to determine the nature of the faults along the joints and the manner in which the area as a whole has been deformed through the depression of the orographic blocks which the joints have conditioned. Compression of the area in a nearly east-west direction is believed to have found relief in the prevailing dislocations. The drainage-system of the area is finally considered, and it is found that the streams have been directed in their courses to correspond with the direction of the prevailing fault-series. The work of ice is also briefly discussed. Mr. F. H. Knowlton reports on the silicified wood from the Newark formation.

The laccoliths of the Black Hills in South Dakota and Wyoming are described by Mr. T. A. Jaggar, jun. It is shown that igneous intrusions of rhyolite and phonolite accompanied or immediately followed a great uplift in the area. This uplift arched the horizontal strata of the plains into an elongated dome, while schists beneath moved up irregularly on nearly vertical plains of schistosity. The igneous matter arose through the steeply inclined schists and spread out among the sediments which lay unconformably across the older rocks. The intrusion is regarded rather as an effect than as a cause of the great uplift. Mr. Ernest Howe describes a number of experiments undertaken to imitate the processes involved in the formation of laccoliths. These prove that low viscosity favours wide lateral extension to form sills; high viscosity produces thick lenticular bodies. Moreover, the intrusive material thickens into domes where a resistant overlying stratum locally thins. A stratigraphical obstacle may also cause a sill to thicken into a laccolith.

The iron-ore deposits of the Lake Superior region are further treated of by Mr. C. R. Van Hise. He points out that the region is the most important in the world for the production of the metal. In 1900, it yielded more iron than the maximum product of Great Britain. He, however, mentions that the exhaustion of the high-grade ores of Lake Superior within a few decades is little short of a certainty. He therefore urges that the material in which the percentage of iron is below the present market demand and which must be handled during present operations should be stock piled. The iron-bearing formations are the Archæan, Lower and Upper Huronian. The ores originated from cherty iron-bearing carbonate, and to some extent the ore bodies are due to the oxidation of the iron carbonate in place; but they are mainly to be attributed to the secondary enrichment by downward percolating waters below crests or slopes, where such waters were converged by the pitching troughs in the strata.

The Arkansas bauxite deposits are described by Mr. C. W. Hayes. At present, this mineral has been discovered in commercial quantities in only three areas in the United States. The Arkansas bauxite occurs in the Fourche Mountain district and in Bryant Township. At Bryant, it rests on kaolinised syenite and has a thickness of 10 or 15 feet, and in some places possibly 40 feet. While largely a chemical precipitate, it has some features of an ordinary detrital sediment. Some of it is pisolitic, while the whole is of this character in the Fourche Mountain district. The deposits are considered to have been due to the action of heated alkaline waters on the syenite, and to subsequent superficial chemical reactions on the deposits left by the springs.

The Tennessee white phosphate is also described by Mr. Hayes. Much of it appears to have been formed by deposition from solution in cavities of limestone.

Mr. G. F. Becher's report on the geology of the Philippine Islands has previously been noticed, a reprint in advance having been received.

PART IV.—*Hydrography.*

This volume contains an elaborate report on the progress of stream measurements for the year 1899, by Mr. F. H. Newell. There is also a preliminary description of the geology and water resources of the southern half of the Black Hills and adjoining regions in South Dakota and Wyoming, by Mr. N. H. Darton. More precise and comprehensive knowledge of the artesian waters in the Dakota sandstone and other widely distributed water-bearing rocks rendered necessary a detailed study of the area. Cambrian, Carboniferous, Jura-Trias, Cretaceous, Tertiary

and Pleistocene strata are described, with especial reference to underground and surface waters, soils and mineral resources. Cretaceous coal, also gypsum, petroleum, fuller's earth in Tertiary strata, and other economic products are noted.

A report on the High Plains and their utilisation is contributed by Mr. W. D. Johnson. This region lies on the borders of Colorado, Kansas, New Mexico and Texas, and it corresponds approximately to what is sometimes called the Central Plains region. In the broad sense, it is a plain; in reality, it is a surface of degradation with topographic diversity. There is practically no drainage, the local precipitation being absorbed. The question of utilisation must depend on wells. The author deals fully with the origin and capabilities of the area, but his report has been left incomplete.

PART V.—*Forest Reserves.*

This volume, with accompanying atlas, deals exhaustively with timber regions.

PART VII.—*Texas.*

This contains an account of the geography and geology of the Black and Grand Prairies, Texas, with detailed descriptions of the Cretaceous formations and special reference to artesian waters, by Mr. R. T. Hill.

Pre-Cambrian schists, granites and crystalline limestones, and a series of Palæozoic and Permo-Triassic rocks form the floor of this region, and above are Cretaceous formations which are by far the most important in area and economic value. Their texture and stratigraphic arrangement conduce to the transmission or retention of underground waters in extensive and prolific artesian well-systems. They yield the most valuable soil, building material, cement, and some oil-fields. These Cretaceous strata are therefore described in considerable detail, and numerous plates of fossils are given. Various superficial deposits are likewise described.

We have received several series of *Bulletins* of the United States Geological Survey.

Series A. *Economic Geology.*—No. 180 is on the occurrence and distribution of corundum, by Mr. J. H. Pratt. The localities for corundum in the United States, with the exception of those in Montana, Colorado and California, are limited to the Appalachian region, and the mining has been confined to Georgia and North Carolina, and to the emery mines at Chester, Mass. The author includes, not only the ordinary translucent to opaque varieties of corundum, but also the sapphires and emery, which is a mechanical admixture of corundum, magnetite and hæmatite. He deals very fully with the uses and distribution of the minerals.

No. 182 is a report on the economic geology of the Silverton Quadrangle, Colorado, by Mr. F. L. Ransome. Gold, silver, copper and lead have been obtained, and it is probable that zinc ores may be worked. Fissures carrying variable amounts of ore occur in all the rocks of the area, from the Algonkian schists to the later monzonitic intrusions that cut the Tertiary volcanic series. By far the greater number are found in the volcanic rocks of the San Juan series (andesitic breccias) and of the Silverton series (massive andesite, rhyolitic and other breccias), both of Tertiary age. Detailed descriptions of the mines and of special areas are given, and the origin of the lodes is discussed.

No. 184, on the oil and gas fields of the Western Interior and Northern Texas Coal-measures, and of the Upper Cretaceous and Tertiary of the Western Gulf Coast, is by Mr. G. I. Adams. The shales of the Coal-measures are very bituminous and give evidence of the presence of organic matter in great abundance at the time of their deposition. The burying of this material and its subsequent decomposition gave rise to the oil and gas. The reservoirs are usually sandstones which vary in porosity, while the shales serve to seal in the oil and gas. The oil which occurs in the Cretaceous and Tertiary strata is associated with sulphur, gypsum and rock salt. Mendeléeff's theory, that petroleum is formed by the action of heated water on carbide of iron, is briefly discussed. Particulars are given of the production of oil and gas in different localities.

No. 193, geological relations and distribution of platinum and associated metals, by Mr. J. F. Kemp. This gives a general account of these metals, and of their mode of occurrence and distribution. It is concluded that platinum is very sparsely distributed in its mother rock. It has been mostly derived from peridotites, and the chances of finding it in quantities sufficient to mine are small.

No. 178 (not included in the economic series) deals with the El Paso tin deposits in Texas. The ores comprise abundant cassiterite and wolframite in a quartz gangue, and the veins exhibit characters similar to those of Cornwall.

Series E. *Chemistry and Physics.*—No. 186, on pyrite and marcasite, by Mr. H. N. Stokes. The author points out that much uncertainty exists in distinguishing these minerals by the usual methods. Specimens crystallising in the regular system are true pyrite, while those forming rhombic crystals are marcasite.

Series F. *Geography.*—Comprises Nos. 181, 185 and 194, which deal with the results of primary triangulation, of spirit levelling and observations on the north-west boundary of Texas. Nos. 183, 187, 190 and 192 are gazetteers of Porto Rico, Alaska, Texas and Cuba.

Series G. *Miscellaneous.*—Comprises No. 188, bibliography of North American geology, &c., for 1892–1900, inclusive, and No. 189, index to the same. These will prove of great value for reference. With them we may include No. 179, a bibliography and catalogue of the fossil vertebrata of North America, and No. 177, catalogue and index of the publications of the United States Geological Survey, 1880–1901.

Monograph vol. xli. of the United States Geological Survey (1902) contains an essay on the Glacial formations and drainage features of the Erie and Ohio basins, by Mr. Frank Leverett. He describes in some detail the drift deposits which extend over a large area southwards from those lake-basins to the vicinity of the Allegheny and Ohio rivers. The soils, peat-beds and weathered zones which mark intermediate stages in the glaciation; the lakes which were formed in front of the retreating ice; and, generally, the past and present systems of drainage are discussed and explained.

A separate volume on the mineral resources of the United States for the year 1900, by Mr. David T. Day, is the seventeenth annual report on this subject issued by the United States Geological Survey. It shows a continuation of the remarkable activity in the mineral industries of the country. While coal and iron are the most important products, copper, lead, gold and manganese ores show an increase, as do petroleum, natural gas, stone, clays and other materials. The production of quicksilver, antimony and nickel, of phosphate rock, bauxite and fuller's earth has decreased.

We have, further, received the fourth volume issued by the Maryland Geological Survey, a work, as usual, sumptuously printed and illustrated. Mr. Bailey Willis contributes an essay on the history of Maryland during Palæozoic time. He gives an account of the growth and wasting of several mountain systems, the expansion of great plains and their submergence, and of the folding and dislocation of the strata. He concludes with a brief account of the influence of the older history on the later geological changes.

Other portions of this volume deal with the economic geology, the highways and tests of road-materials, and there is an important report on the clays of Maryland, by Mr. Heinrich Ries, the leading clay expert in the country. He discusses the properties of clay, chemical and physical, and shows how their bad qualities can be offset by the addition of proper ingredients. There is also a full account of the principal clay deposits of the State. A great variety of clays is found, but at present no fuller's earth. The essay may be profitably studied by all interested in clay-deposits.

ANTHROPOLOGY: ITS POSITION AND NEEDS.[1]

THE practical difficulty of drawing a dividing line between the legitimate scope of anthropology and that of other studies is so great that we are often told there is no science of anthropology. This absence of definiteness adds a charm to the subject and is fertile in the production of new ideas, for it is at the fringe of a science that originality has its greatest scope. It is only by a synthesis of the various studies which are grouped together under the term anthropology that one can hope to gain a clear conception of what man is and what he has done. After giving

[1] Abstract of an address to the Anthropological Institute by the retiring president, Dr. A. C. Haddon, F.R.S., January 26.

a brief classification of the subjects included under the general term of anthropology, Dr. Haddon said his reason for touching on the subject at all was to suggest a general survey in the hope that fellow-students may carefully consider the lines upon which future research may be undertaken with profit, as there are times and occasions when one branch of inquiry is more immediately desirable than another. A few remarks were made on certain aspects of anthropological research, and various lines for future investigation were indicated.

A claim was made that the ethnological material now being collected from all over the earth is an indispensable contribution to the science of history. It is a truism that history repeats itself, and historians were invited to consult the modern instances that are accumulating, as they will find many suggestions that will serve to throw light upon past events, which otherwise might remain obscure. It is hardly an exaggeration to say that new life has been given to classical studies by the introduction into the universities of original archæological investigations, comparative archæology, ethnology and folklore. Allusion was made to the recent signs of an interest in ethnological inquiry by various Governments of the British Empire. "Is it too much to hope," it was asked, "that at last it is being recognised that a full knowledge of local conditions and a sympathetic treatment of native prejudices would materially lighten the burden of government by preventing many misunderstandings, and by securing greater efficiency would make for economy? . . . We have not yet exhausted other methods of advancing anthropology, we have scarcely yet endeavoured to educate the masses or to interest individuals who have time or money at their disposal. Few people have any idea of the great wealth of human interest there is buried in the data in the journals of our societies, or locked up in the cases and drawers of our museums. It is this practically unexploited wealth of interest and information that we should endeavour to disseminate. The apathy of the public to our science probably is largely due to its students. . . . I have indicated some of the lines upon which our Cinderella science is advancing, but before I finally vacate the honourable position to which you have called me, I must return once again to its most pressing need.

"Students at home spend laborious hours in reading, transcribing or collating the records of travellers, and in endeavouring to make them yield their secrets. The safety of the student usually depends upon the bulk of his material, but when one considers the sources of his information, one is sometimes appalled at the dangers he runs. The data that are available have been collected in varied circumstances by men of every degree of fitness and reliability. There are but two remedies for this state of affairs—trained observers and fresh investigations in the field. Fortunately, we are now in a position to say that means do exist for the training of field-anthropologists. Those who have had practical experience in Oceania, or who followed the literature of that region, will fully acknowledge the urgent need there is for immediate field-work. But the same pressing necessity is manifest in every quarter. Nor is it a call that we can neglect with impunity and postpone until a more convenient season. Each year sees a decrease in the lore we might have garnered, and this diminution of opportunity is taking place with accelerating speed. Oh! if we could only agree to postpone all work which can wait, and spend the whole of our energies in a comprehensive and organised campaign to save for posterity that information which we alone can collect."

ELECTRICITY AND MATTER.[1]

THE subject I have chosen is an enormous one, but it is one of exceptional interest at the present time. It is one of general interest as well as of scientific interest to students of physics. The fundamental properties of matter are now coming to be understood in a way in which they have never been understood before. What are these fundamental properties? One is cohesion, another is gravitation, and another is inertia. Concerning gravitation, we remain pretty much in the dark. It is an empirical fact that a body has weight, that two lumps of matter attract one another, with an extremely small force when we are dealing with ordinary pieces of matter, but extremely large when we are dealing with astronomical masses, such as planets or suns; but the cause of that gravitative attraction is not known, and at present appears to have little chance of becoming known. Cohesion ten years ago was in the same predicament, but cohesion now seems to be on the eve of yielding up its secret. The most striking fundamental property of matter, however, that we are beginning to understand in some degree, is that of inertia. Inertia is a popular term, but it is not always clearly understood what is meant by it. Let me explain the meaning. It may be defined as the power of overshooting the mark, or the power of moving against force. It is by inertia that a rifle bullet travels after it has left the gun. In the barrel it is urged by force; in the air the bullet goes on against an opposing force of friction because of its inertia—often in that case called the momentum. It is by reason of inertia that water runs uphill; we are sometimes told that water will not flow uphill, but that is a mistake. Heat will not flow uphill—heat will only flow from hot to cold; you cannot give it impetus and let it rush up of its own momentum, for heat has no momentum; it is not a substance, it only goes when it is pushed, and the instant you remove the force it stops. That is the case with heat, but that is not the case with any form of matter—it is not the case with anything possessing inertia. The water from a fountain rises because of the initial velocity imparted to it; for the same reason a cricket ball rises when it is thrown up; the propelling force has ceased, but the motion continues. It is the same with tides; for three hours the water is running uphill, for three hours it is running downhill. The head of the inflowing water is for three hours higher than the water behind it—the first three hours of the flow impart to the water its momentum, and the last three hours destroy that momentum gradually. The swinging pendulum is another illustration. [Having illustrated this point by a liquid in a horseshoe tube, showing the return to the position of equilibrium after a series of oscillations, the lecturer continued.] Oscillations like that are known to occur in electricity when a Leyden jar is discharged; the electricity does not go simply from the more highly charged to the less highly charged and there stop, but it goes beyond, it overshoots the mark and charges up that which was negative to positive, and then backwards and forwards, very like the oscillations in the tube. Hence it would appear as if electricity had a property resembling inertia. When I lectured here a quarter of a century ago I should have said that electricity had a property *resembling* inertia—I should have called it a mechanical analogue—an apparent inertia, simulating by inductive electromotive force the real inertia of matter. I should now go further than that, and should say that electricity has real inertia, just as real as matter; I should even go still further, and should say that in all probability there is no inertia but electric inertia; that the inertia of matter itself is to be explained electrically. In other words, what we are now arriving at gradually is *an electric theory of matter*. We are endeavouring to explain the properties of matter in terms and by means of what we know concerning electricity.

Although it may sound paradoxical to people who have not studied physics, we know more about electricity than we do about matter. Its properties have been more clearly investigated and more clearly understood than the inertia of matter, which is not understood at all. We only know its behaviour:—If a body is subject to a positive force it gradually increases its speed; if it is subject to an obstructive force it does not move in the direction of that force necessarily at once, but its motion begins to decrease, gradually stopping, and ultimately reverses its direction, if the force is continuous and if it is an active force. Many obstructive forces are only able to oppose motion like friction. In the text-books a bad example of a body obeying the first law of motion is given in the throwing of a stone upon ice, or some smooth surface. That is a bad example, because a single obstructive force acts all the time. The best example to give of the first law of motion is a case

[1] A lecture delivered at Bedford College for Women, on February 5, by Sir Oliver Lodge, F.R.S. Reported from shorthand notes.

where there is a pair of balanced forces, where a propelling force acts all the time, just sufficient to overcome friction; *e.g.* a barge pulled by a horse, or a train drawn by a locomotive. When such a thing starts, the force is greater than the resistance, and the speed accelerates; when it stops, the resistance is greater than the propelling force; but when it is going on at a steady speed, *i.e.* for the major part of its journey, the force and the resistance precisely balance. The resultant force acting upon it is nothing. It is obeying the first law of motion. The barge moves, or the ship moves, or the train moves, simply and solely because of its own inertia. All the energy of an engine goes to generate heat and to overcome resistance. There is no propulsion in that; when it is going at a steady pace the positive and negative forces balance; the body is subject to zero force and obeys the first law of motion.

Now this property, a property analogous to inertia, belongs also to electricity; it was called self-induction, and its laws have been made out for a long time, a law known as Lenz's law, which says that any change in a current is such as to oppose the motion. If you have a current of certain strength any cause which increases that strength calls out an antagonistic force. The force called out is always antagonistic to any change in the current. When a current is weakened, self-induction tends to make it persist in retaining its old strength. It is a property precisely analogous to inertia, and I now wish to suggest or maintain that it is a property which actually is inertia. It depends on a property which was first brought out mathematically by considering the case of acceleration of a charged body.

In a sphere charged with electricity, as long as it is at rest, we have the phenomena of electrostatics; directly it is in motion we get the phenomena of current electricity. A charged sphere in motion is a current, and we have to realise that there is no other current but that; a current is surrounded by magnetic lines of force; and when a sphere or other body charged with electricity is put into movement, a set of concentric circles of magnetic force surrounds its path, giving rise to a magnetic field. That magnetic field may seem extremely weak, but it is the measure of the current; and whether weak or not, it is now believed to be the only kind of magnetic field which exists. We are coming to realise that there are three things—a charged body, a charged body in motion, and a charged body in accelerated motion; the first gives us electrostatics, the second gives us magnetism, and the third gives us two things, first the evidence of inertia, and secondly radiation. Inertia and radiation are not the same thing, but both are manifest throughout the accelerated period. Inertia no doubt exists all the time; and instead of radiation I will use the more general term of "light"—light being the best known form of radiation. I will put inertia in a class by itself, because, although it is only manifested when there is radiation, it exists all the time. It does not depend on the speed, it is constant, and may be taken to exist equally well when a body is at rest. I want you to realise that just as there is no other electric field but that due to a charged body, so there is no other current or magnetism except that due to a charged body in motion, and there is no other radiation except that due to an accelerated charge; further, that one kind of inertia is the inertia of the charge on a body, and that *probably*, but not yet certainly, there is no other inertia except electric inertia.

With the time at our disposal it is impossible to give you all the steps leading to this conclusion, I can only give you a summary of the results. The idea of electric inertia as a reality and as due to a moving charge took shape and form in a magnificent paper by Prof. J. J. Thomson, of Cambridge, which appeared in the *Philosophical Magazine* in 1881, one of the most striking productions in the recent history of mathematical physics. It was a paper on the properties of a moving charged sphere, and it showed that a charged body possesses inertia because it is charged. It is important to remember that a body when it possesses a charge has, in addition to its ordinary mass, a supplementary mass, as it were, proportionate to the square of the charge, and inversely as the radius of the sphere on which it exists; or, as we may also put it, it is proportional to the quantity and to the potential. No great importance was attached to the statement at the time because of the difficulty of detecting any increase of inertia due to the electric charge in the case of a sphere of appreciable size. The extra inertia would be excessively small and impossible to detect if the sphere is of any perceptible size. Even if the sphere is reduced in size until it is a mere atom, and charged as highly as the atom can be charged, still the inertia due to the charge would only be an insignificant amount of the whole—not more than one hundred thousandth part of the whole. That is to say, if you had one atom of matter charged with the maximum quantity which it can possess, and which you know in electrolysis or in chemistry, and if the inertia of the atom itself was one hundred thousand units, then when the charge was added it would be one hundred thousand and one; no important difference and not experimentally to be detected.

It depends, however, entirely how small the body is; the smaller the radius the bigger the inertia, due to the charge, will be. For a long time nobody thought of anything smaller than the atom, that was thought to be the limit, hence electric inertia seemed to be no more than a matter of mathematical curiosity. But about the year 1870 Sir William Crookes called attention to the phenomena that went on in vacuum tubes, and considered that the kathode rays were matter in a "fourth state," neither solid, liquid, nor gaseous. Sir William Crookes was not believed, and was rather jeered at for speaking of matter in a fourth state. However, the subject was investigated by a great number of different people in this country and in Germany; and the result of these researches, in which Prof. Schuster and many others, and notably Prof. J. J. Thomson, engaged, has been to show that Sir William Crookes was perfectly right; that the matter in the vacuum tube flying in these kathode rays is not solid, nor liquid, nor gaseous, does not consist of atoms as had been thought propelled by the kathodes and flying through the tube and causing phosphorescence where they strike, or X-rays, as the case may be, but that they consist of something much smaller than the atom, fragments of matter, ultra-atomic corpuscles, minute things, very much smaller, very much lighter than atoms—things which appear to be the foundation stones of which atoms are composed. Thomson measured the mass of these particles and found that they were of less mass than the atom of hydrogen; whereas the atom of hydrogen had been the lightest body hitherto known. These small corpuscles were about the one-thousandth of an atom of hydrogen in mass, and he further made this important observation, that whether hydrogen or oxygen or carbonic acid or any other gas was in the tube, the particles into which these substances seemed to be broken up by electric action were identical and independent of the nature of the gas in the tube. That is to say, the things shot out by the kathode did not depend upon what gas was in the tube; they seemed to be fragments of the atoms of the gas, but they were the same fragments in each case. This at once suggested the hypothesis, not yet by any means completely verified, that all atoms of matter may be composed of these same corpuscles, or electrons as Dr. Johnstone Stoney had called them. Dr. Stoney had a habit of being in the van and of naming things before they had been discovered; thus they were called electrons long before they were known to exist separately—only the name belonged to the charge of an ion in electrolysis—a charge associated with matter; but in a vacuum tube these same charges are detached from the atom and fly free, a thing previously unheard of. In liquid conduction the charge and the atom travel together, they are inseparably associated; at an electrode or solid conductor the electron or charge is handed on to the metal and goes along the wires by some other means, but while they are travelling they are definitely united or attached to atoms all the time, although passed from hand to hand; in a gas it is not so, for it is just as if charges had been knocked off, charges of electricity dissociated from the matter, disembodied charges or electric ghosts flying through the tube at a tremendous speed. It was not only possible to measure the mass of the particles, it was also possible to measure their speed, and their speed was found to be something comparable to that of light, about one-thirtieth or sometimes even one-tenth of the velocity of light. Anything moving with that prodigious speed of several thousand miles per second must have a great amount

of energy, and when stopped by a target naturally considerable results are produced.

Now for radiation of any kind there must be acceleration. The greater the acceleration the stronger the radiation. If you want violent radiation take a quickly moving charged body, and stop it dead; which is just what you do in the production of X-rays, and what is done to some extent by minerals exposed to the kathode rays. These corpuscles have extremely small mass, and so their inertia is extremely small, but a body, no matter how small, moving with the speed of light, must have terrible energy; thus, by way of illustration, the energy of a gramme of matter (15 grains) travelling at the speed of light would be sufficient to lift the British Navy to the top of Ben Nevis. After the speed of these corpuscles that of bullets is rest in comparison. [Having shown by experiment a vacuum tube containing electrons in motion, the lecturer proceeded.] To show that these are charged particles in motion, it is only necessary to show that they have the properties of a current, that is, that they are amenable to magnetism—such as that of an ordinary steel magnet—and what you see going on in the tube is the nearest approach you have to seeing electricity. In that tube electricity is as isolated and as separated as we can ever hope to have it.

All electrical phenomena seem to depend upon these electrons. In the case of gaseous conduction what we observe is the flying of the particles—the bullet method or electric particles in free flight. When we deal with liquid conduction it is the slow travelling charges moving, but retarded or loaded with the atom of matter, having to convey the atom of matter with it; hence they travel very slowly, the atoms jostle and have to work their way through the rest of the material, and instead of going something like 1000 miles a second they go more like an inch an hour; it depends upon what gradient of potential is applied. That I call the bird-seed method, meaning that the charge is carried as a bird carries a seed, the bird and seed travelling together until they arrive at an electrode, when the electron is dropped. In the case of solid conductors or metals the atoms cannot move along as they do in the liquid, they can only vibrate a little, are fixed, rigid, crystallised into their places. So when the electrons travel it must be because they are handed on from one to the next; each receives one and passes it on, not necessarily the same one; and this may be called the fire-bucket method.

A word more about radiation. If conduction is explicable in this way, how is radiation to be explained? Until quite recently radiation has been a puzzle. Atoms of matter vibrate; radiation is waves in the ether. Hence it used to be thought, and it did not seem puzzling at that time, that vibrating atoms of matter could generate waves in the ether just as a bell can generate waves in the air. The method by which light is generated was not clearly understood, but it was thought to be something analogous to the production of sound by a tuning fork or bell. But certain experiments made by me at Liverpool showed that matter and ether are disconnected from one another—that matter alone cannot generate these waves. It becomes necessary to assume that it is not matter which is vibrating so much as the charge on the matter—that radiation is caused not by the atom itself, but by the electron which it carries. It is during the accelerative period that radiation occurs. If the atom simply carries a charge along there is no radiation. There is nothing visible in the kathode rays as long as they are travelling with uniform speed and direction; it is when they are accelerated, started or stopped, or curved, that radiation occurs. The electron instead of simply vibrating might be revolving round the atom like a satellite; that would be centripetal acceleration, which is just as effective as longitudinal acceleration.

But if radiation is due to an orbital motion of an electric charge, it ought to be amenable to a magnetic field; every motion of an electron constitutes an electric current, and electric currents are amenable to a magnet. A source of light put between the poles of a magnet ought to show some difference. Faraday tried many experiments in this direction and failed, because the appliances available in his day would not show it. Nowadays, with a Rowland grating, the spectrum is much better defined, and a few years ago Zeeman, of Amsterdam, was able to see the difference when light is magnetised.

It often falls to men of genius to predict a great deal more than their generation can realise. A theory had been given by sundry people, including Fitzgerald, Larmor, Lorentz, and others. Perhaps the theory has been given more completely by Lorentz than by anyone else. It was an interesting case of prophetic prediction. They predicted that the effect observed by Zeeman would follow if light were due to revolving electrons. Time only permits me to indicate the explanation. It comes near to astronomy, and, indeed, it had been worked out six years before by Dr. Johnstone Stoney on astronomical principles. He had fully worked out the perturbations, but had not suggested that they would be caused by a magnet. But Larmor and the others did. They perceived that on applying to an orbit or circular current a strong magnetic field, that orbit will tend to be deflected; the effect of a magnetic field in general is a deflecting force. But as the circulating electron has inertia, the application of a deflecting force will not make it simply obey the force that is applied, but will make it move sideways, like any planetary orbit or a spinning top. A precessional motion is set up. Anything spinning that has inertia does not obey the force but moves at right angles. Thus the revolving electron will not, when the force is applied immediately, set itself normal to the field, but will go round the magnetic lines in a precessional motion; and that precessional motion will analyse the original lines of the spectrum into three. [Here the lecturer gave an illustrative experiment, and proceeding, pointed out that when the polarisation of the lines is examined, the vibrations are precisely as predicted.] It was further found that by the amount of separation of these lines a calculation could be made of what the magnitude of the electric charge was in relation to the inertia of the revolving portions of matter. It was thus found that the radiating particles have just the same inertia and just the same charge as the particles in the kathode rays. All the known phenomena connected with conduction and radiation are allied to these very small particles—the same inertia, the same electric charge, and the same kind of velocities, the mass being something like the thousandth part of a hydrogen atom.

Passing over chemical affinity and cohesion, the lecturer proceeded to discuss other phenomena which are due to these small particles. These particles, in order to give rise to visible radiation, revolve with terrific velocity. The number of vibrations which constitute visible light is from 400 to 800 million million times per second; and although it is no great distance round an atom, yet these particles have to go at very high speed; hence, naturally, some of them occasionally fly off. This will occur from various causes; they will fly off under the action of ultra-violet light, and so give rise to leakage of negative electricity. But there are certain substances which will emit these particles without any stimulus, and the first discovered was uranium. Although there may be aluminium or other screen between a piece of uranium and a photographic plate, something will penetrate through to the photographic plate. This constituted the discovery, by Becquerel, of the radioactivity of substances. In the researches of Dr. Russell various substances were found to possess this quality of giving out something on their own account. But the subject has gone ahead very far and fast. The most important developments have been made by Monsieur and Madame Curie in France, discovering polonium and radium, which latter has the properties possessed by uranium in a most extraordinary degree. The rays given off by these substances are of extraordinary interest; they have marvellous penetrating powers and are very intense, more intense than the X-rays given by a Röntgen tube. Radium rays will not only penetrate a foot of aluminium or wood, but they will penetrate three-eighths of an inch of lead, and then be as strong as are the rays from uranium. The full mechanism of the giving off of this great amount of radiation has still to be further investigated. It is a kind of electric evaporation, an emission of particles; this seems clear. There are three kinds of radiation, (1) particles which are readily stopped by obstacles, absorbable rays;

(2) the particles which penetrate obstacles with singularly penetrating power; and (3) the ordinary X-rays. X-rays are waves in the ether, not light, something of that nature; the penetrating rays are electrons which are shot off. But the most interesting are the first rays, those which are easily stopped; for these turn out to be atoms of matter shot off with a speed comparable to that of light. It is the first time that matter has ever been known to have such a speed as that. Rutherford, now of Montreal, has measured for the first time the speed of these readily stopped absorbable particles, and also their mass. He shows that they are atoms of matter, and that they are moving with one-tenth of the velocity of light.

All hot bodies and all negatively charged bodies are now believed to be giving off these particles; radio-activity is becoming quite a common feature. Recently fallen rain drops are radio-active, leaves of plants and most things in sunshine are radio-active; the difficulty will be to find something which is not radio-active in some degree, and the commonest kind of radio-activity appears to be the detachment of an electron. Loose charges seem to fly off, apparently by centrifugal force or the jostling of the atoms.

The *size* of electrons is known, on the hypothesis that the atom of matter is composed of them, *i.e.* on the hypothesis that the inertia of matter is electrical, or that it is electrically composed of the inertia of these charges. Evidence of this is accumulating, and there is reason to believe, not only on philosophical grounds, but in accordance with direct physical experiment, that electric inertia is the only inertia that exists. The size of an electron can then easily be determined. Regard the radius as unknown, the charge as known, the mass as known; then the size is at once calculable. The size of these electrons is about one hundred thousandth part of the diameter of an atom, otherwise they would not have sufficient inertia. They are the smallest bodies known. There was a time when the atom felt small; it is not big, it is true, but it is getting to feel quite a large thing beside the electron. To illustrate the difference between an atom and an electron, imagine an electron to be the size of a full-stop as here printed, and an atom a church 160 feet long, 80 feet broad and 40 feet high—in an atom of hydrogen there are nearly 1000 electrons—imagine those thousand full-stops thrown into that church, and some idea will be obtained of the relative sizes of the electron and the atom. The electrons *occupy* the atom very effectively; they are energetic and pushful, though not big. They occupy the atom in the sense that soldiers occupy a country, that is, they will not let anybody else in. The electrons, by the force they exert, will not let anything else in, they make the atom impenetrable; they also give the atom its other properties and enable it to act chemically. That chemical affinity is electrical force has been known for a long time; it was suspected by Sir Humphrey Davy. I believe if the atom has no extra or odd electron it has no chemical force; the atom may have molecular force, which is cohesion, and this point might be explained at greater length; for in my ideas cohesion is turning out to be electrical too, though not in the sense of attraction between ordinary positive and negative electricity.

The relation of the electron to the atom is a matter of the most intense interest. But it is not to be supposed that the electron is stationary in the atom. The electrons are revolving round one another at tremendous speed, so that the atom is a region of intense activity. The electrons are not in the least crowded, although there are a thousand in the hydrogen atom, twenty or thirty thousand in the sodium atom and one hundred thousand in the mercury atom; for consider how far apart are they in proportion to their size. Just as far apart as planets in the solar system are in proportion to their size. The distance of the earth from the sun is to the size of the earth very much as the distance of electrons from each other is to their size in a mercury or platinum atom. The fact is, we come to an atomic astronomy, and the atom is becoming like a solar system, or like nebulæ or Saturn's rings or something of that kind, composed of a number of small particles in a violent state of revolving motion and occupying very little of the whole space with their actual substance. They are so small that collisions are infrequent; so it is in the solar system and heavens generally, collisions do occur, but seldom, because of the excessively small sizes compared with the distances at which they are spaced out.

Taking any family belonging to a sun, *i.e.* a solar system, it forms something like the same kind of collection as the electrons form in an atom. So when we get in an atom a sort of solar system we begin to question whether there is anything in absolute size at all. It is a question I cannot answer. It has been suggested that solar systems may be atoms of a still larger universe. These are questions that are too hard. But there appears to be no end to the infinity of the universe, and all that we can say is that the probability is that it is infinite in an infinite number of ways.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject for the Adams prize essay of 1905 is "Wave Motion of Finite Amplitude and Unchanging Type, in Deep Water." The prize is open to the competition of all who have at any time graduated in the University. The value of the prize is about 225*l.* Further particulars are given in the *University Reporter* for March 10.

The new Lucasian professor will next term lecture on "The Theory of Gases and the Molecular Statistics of Energy."

Dr. Anningson and Prof. Woodhead will represent the University at the congress of the Royal Institute of Public Health to be held in Liverpool next July.

IT is reported through Reuter's Agency that a sum of more than 200,000*l.* has been given to Barnard College, New York, to be used for the purchase of the land adjoining the buildings. The name of the donor is not given.

A JUBILEE of the University of Heidelberg will be held next August in commemoration of the revival of the University in 1803 by Charles Frederick of Baden. Though the *fêtes* will be on a more modest scale than those which marked the celebration in 1886, an extensive programme is being arranged for the occasion.

THE London School of Tropical Medicine announces that the Craggs research prize of 50*l.* will be awarded in October to a past or present student of the school who, during the current year, has made the most valuable contribution to tropical medicine. Full information may be obtained from the medical tutor at the school, Royal Albert Docks, London.

THE senate of the Madras University has passed a resolution, it is reported in the *Pioneer Mail*, disapproving of the recommendations of the Indian Universities Commission that the system of examinations by compartments should be abandoned. The Vice-Chancellor of the Bombay University at the recent annual convocation advocated the establishment of a science school, and urged the raising of a fund of twenty lakhs of rupees for the purpose. Part of this money, he said, must come from the public and part ought to be provided from the funds for higher education in the Presidency. He thought the Government might be trusted to provide the remainder.

THE will of Dr. H. E. Schunck, F.R.S., who died on January 13, shows that he bequeathed to Owens College in trust for the foundation of a "Dr. Schunck's Endowment for Promoting Chemical Research," the contents of his laboratory and the apparatus, appliances and instruments, to be administered by the principal and professors of chemistry in Owens College and by two other trustees, to be nominated by the council, and by his son, Mr. C. A. Schunck, if he shall be willing to serve. The endowment is for the purpose, not only of research in chemical science, but also of geological, physiological and other sciences, and reports are to be annually presented to the council of the college.

IN the House of Commons on Monday Mr. Brodrick stated that many of the recommendations of the Military Education Committee are to be accepted. The new Director-General of Military Education and Training is to have an advisory board as suggested by the Committee. This body is to consist of the heads of Woolwich, Sandhurst, the Staff College, and the Ordnance College, of two representatives

of the Universities, a representative selected by the Incorporated Association of Headmasters, another selected by the Headmasters' Conference, another by the Royal Society, and two members nominated by the Secretary of State. The settlement of the syllabus of examination will be left in their hands. There is to be one and the same examination for Woolwich and Sandhurst for the Army and for the Militia. For University candidates, whom Mr. Brodrick is anxious to encourage, a scheme has been prepared which will enable them to enter the Army on equal terms with other candidates. A student will have to pass Moderations at Oxford or some equivalent examination at another University before he is twenty, and he will also have to do six weeks' training with a Regular unit at Aldershot or elsewhere. He will then be given a provisional commission. Before he is twenty-two he will have to take honours at the University and to go through another six weeks' training. He will then receive a commission dating back two years. The Universities are to be asked to include in their honours examination two or three military subjects—*e.g.* military topography and military history.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 22.—"Characteristics of Electric Earth-current Disturbances and their Origin." By J. E. **Taylor**. Communicated by Sir Oliver Lodge, F.R.S.

The paper deals with disturbing effects, produced by rapidly varying earth-currents, on a telephone receiver, connected in a short line of telegraph having both ends earthed in the sea. The sounds produced have certain well-marked characteristics. In these latitudes they are always stronger and of more frequent occurrence in summer than in winter. They are daily in evidence for a few hours at, or about, the time of sunset, *i.e.* whilst daylight is fading. In general they do not evidence themselves to any great extent during broad daylight, but are readily precipitated by a state of electrical tension in the atmosphere which may culminate in a thunderstorm, and rarely fail to herald the approach of a storm or gale.

Particularly noticeable among the various types of disturbance enumerated, there are some which resemble the distant scream of a rocket rising in the air. These commence with a shrill whistle, and die away in a note of diminishing pitch. They vary in intensity, but always have a similar duration of from two to four seconds, are freely heard at night, and only occasionally during the day. The sound is characteristic of an initial high velocity rapidly damped and dissipated. This type of disturbance is assumed to be produced by the passage of meteoric bodies in sufficient proximity to the circuit, which set up rapidly intermittent electrical discharges in the upper regions of the atmosphere, inducing electric currents in the sea which affect the circuit. That they are only occasionally heard during broad daylight is explained by the ionisation of the upper atmosphere by solar radiations, possibly electronic, which interposes a conducting screen. A high state of electrical tension in the atmosphere nullifies or modifies the conductivity produced. At nightfall solar radiations cease to act, and conductivity disappears gradually. The nightfall disturbances are accounted for by aërial electric currents associated with the disappearance of ionic conductivity, the effects of these aërial currents becoming perceptible so soon as the conductivity becomes sufficiently small to act no longer as a screen. It is suggested that similar causes influence the diurnal variations of the earth's magnetic field, and that the changes of ionisation of the atmosphere offer a reasonable explanation of the greater night-time efficiency in signalling recently observed by Mr. Marconi in experiments with Hertzian wireless telegraphy.

"Some Dielectric Properties of Solid Glycerine." By Ernest **Wilson**, Professor of Electrical Engineering, King's College, London. Communicated by Sir William Preece, K.C.B., F.R.S.

February 12.—"The Brain of the Archæoceti." By Dr. G. Elliot **Smith**. Communicated by Prof. G. B. Howes, F.R.S.

"Primitive Knot and Early Gastrulation Cavity Coexisting with Independent Primitive Streak in Ornithorhynchus." By Prof. J. T. **Wilson** and Dr. J. P. **Hill**. Communicated by Prof. G. B. Howes, F.R.S.

Linnean Society, February 19.—Prof S. H. Vines, F.R.S., president, in the chair.—Mr. John **Clayton**, of Bradford, presented a set of thirty-two photographs to illustrate the celebrated Cowthorpe Oak, near Wetherby, Yorkshire. The author concludes that the age of the tree has been greatly over-estimated, his own belief being that 500 years is the extreme limit of its age, from sapling to its present decrepitude and decay.—Dr. George **Henderson** offered some remarks on the possible uses of essential oils in the economy of plant-life. Adverting to the well-known fact that moisture in the air prevents radiation and consequent loss of heat, he suggested that emanations of essential oil from plants might possibly prevent damage by night frost during the period of flowering, basing his suggestion on Prof. Tyndall's researches thirty-two years since, on the presence of infinitesimal quantities of essential oil in the air. Tyndall found such presence increased the absorptive power of the air as regards heat-rays: taking dry air as 1, air saturated with moisture as 72, then traces of essential oil rank as follows:—Rosemary 74, cassia 109, spikenard 355 and aniseed 372. Dr. Henderson brought these remarks before the meeting as an interesting question for botanic investigation, since essential oils are usually regarded as mere waste products.—The Rev. T. R. R. Stebbing, vice-president, having taken the chair, the first paper, on the electric pulsation accompanying automatic movements in *Desmodium gyrans*, by Prof. J. C. **Bose**, was summarised by the president for the author. In this paper Prof. Bose gives the results of his investigation of the question as to whether or not spontaneous movements are accompanied by an electric disturbance comparable to that resulting from external stimulation. Spontaneous movements are not uncommon in the higher plants, but for various reasons there are but few instances suitable for an investigation of this kind. The most striking case is that of *Desmodium gyrans*, the telegraph-plant. The leaf of this plant is trifoliolate, consisting of two small lateral leaflets and a larger terminal leaflet. The lateral leaflets move up and down, like the arms of a semaphore—whence the popular name of the plant—the period of a complete up and down movement, in the plants observed, being about $3\frac{1}{2}$ minutes. Having placed one electrode on the petiolule of a leaflet and the other on the petiole of the leaf, both in connection with a galvanometer, Prof. Bose found that the spontaneous movement is associated with an electrical disturbance of a peculiar kind. There is first a large principal wave of disturbance, followed by a smaller subsidiary wave, the period of the former being about 1 minute, that of the latter about $2\frac{1}{2}$ minutes. This disturbance is the expression of a "current of action" travelling in the plant from the excitable petiolule to the resting petiole.—A paper by Miss A. L. **Embleton**, communicated by Prof. G. B. Howes, was read by Mr. A. D. Michael for the author, on *Cerataphis Lataniae*, a peculiar Aphid. This insect was observed in 1901 on various orchids in the Cambridge University Botanic Garden. The author gives the detailed synonymy of the creature, which is well known to cultivators on the Continent, and proceeds to set out its life-history; in this country it exists in only one form, reproduced parthenogenetically, corresponding to an aleurodiform stage of a migratory Aphis. The author concludes by suggesting that it is one of the migratory Aphides which has been deprived of its usual series of metamorphoses owing to an artificial mode of life.—On specialisation of parasitism in the Erysiphaceæ, by Mr. E. S. **Salmon**. The author began by explaining the term "biologic form" or "species" by instancing two fungi which were not distinguishable morphologically, acting in diverse fashion on the same host-plants. This phenomenon has been known in the Uredineæ for some time, but its discovery in the Erysiphaceæ was more recent.

Royal Microscopical Society, February 18.—Dr. Henry Woodward, F.R.S., president, in the chair.—Dr. Arthur **Rowe** gave a demonstration on the photomicrography of opaque objects as applied to the delineation of the minute structure of chalk fossils. Dr. Rowe said the photomicro-

graphy of opaque objects was not so easy as that of transparent objects, for though the broad principles seemed very simple, there were difficulties quite unknown to those who only photographed transparent objects. He used a long camera with powers from 6″ up to $1\frac{1}{2}$″, and had found the incandescent gas light was the best light for the purpose. Success entirely hinged upon obtaining a good contrast of light and shade, and in addition to the difficulties in connection therewith, a great obstacle arose from the inequality of the surfaces of many objects, which rendered focusing troublesome.

EDINBURGH.

Royal Society, February 2.—Prof. James Geikie, F.R.S., in the chair.—The meeting was devoted to papers giving some of the preliminary results obtained last season during the bathymetrical survey of the Scottish fresh-water lakes under the direction of Sir John Murray, K.C.B., F.R.S.—Dr. T. N. **Johnston** gave an account of Loch Morar and the neighbouring lochs Beoraid and Nostarie, which drain into it, showing that Loch Morar, with a maximum depth of 1009 feet, is the deepest known British lake. There are seven European lakes known to be deeper, but only three of these exceed it in depth below sea-level. At the time of surveying, the surface of Loch Morar was found to be 30·5 feet above sea-level, and its mean depth is calculated at 284 feet. Loch Beoraid has a maximum depth of 159 feet, and its surface was found to be 170 feet above sea-level. Loch Nostarie, with a maximum depth of 35 feet, is a shallow loch lying in the drift at a height of 89·3 feet above sea-level.—Mr. T. R. H. **Garrett** read a paper on the temperatures in Lochs Morar, Eilt and Dubh (Ailort). The depth of Eilt is 119 feet, and that of Dubh is 153 feet, whilst their heights above sea-level are 96 feet and 103 feet respectively. The temperature in the western portion of Eilt was higher at all depths than in the central, and higher in the central than in the eastern; this was attributed to the north-east winds of the previous week. The temperature in Loch Dubh on July 12, 1902, was 59°·0 at the surface and 43°·5 at the bottom, which is the greatest range observed on any one day in any Scottish loch during last year. This was attributed to the small area of the loch compared with its depth, and to its extremely small drainage area. He placed the limit of penetration of heat due to solar radiation in Loch Morar at 800 feet, and compared this limit with that of 300 to 450 feet in Lake Geneva as given by Forel.—Mr. James **Murray** read a paper on the pelagic life in the lochs, and gave a summary of the biological work done during the season. Most of the Entomostraca and Rotifera, and all the lower forms, were found to be very uniformly distributed. In the Calanidæ two species of Diaptomus, viz. *D. Wierzyskii* and *D. laciniatus*, were shown to be generally distributed in the north. In the large and deep lochs such as Morar and Tay, only a few species of almost cosmopolitan distribution constitute the fauna of the open water. In smaller lochs life is much more abundant. The total absence of Daphnia from Loch Morar and some other lochs might suggest an investigation into the composition of the water and other conditions of these lochs. In regard to the vertical migration of pelagic animals, it was found on one occasion in Loch Treig that the Copepoda were abundant at a depth of from 40 to 90 feet, but scarce nearer the surface. Some curiosities of distribution were given, such as the occurrence of great numbers of the empty cases of Clathrulina in several large lochs, although the animal was never found alive in any loch.

PARIS.

Academy of Sciences, March 2.—M. Albert Gaudry in the chair.—The storm of March 2, 1903, by M. **Mascart**. Mention is made of the usefulness of the meteorological station at the Azores. The barometer stood at 7 p.m. at 775 mm. at Horta, in the Azores, whilst in the north of Ireland at the same time it was 725 mm., a gradient of 50 mm. between the two stations, an altogether exceptional value, and which fully explains the violence of the storm.—On the absorption of light (1) by a body naturally heterotropic and on which an intense magnetic field has impressed a strong rotatory power, and (2) by an isotropic body, which such a field renders both birefringent and asymmetric, by M. J. **Boussinesq**.—The preparation and properties of two tetra-alkyl-diamido-diphenylanthrones, by MM. A. **Haller** and A. **Guyot**. The tetramethyl-diamido-diphenylanthrone is obtained in good yield by the condensation of the chloride of anthraquinone with dimethyl-aniline in carbon bisulphide solution in presence of aluminium chloride. The corresponding ethyl compound is obtained in a similar manner, diethyl-aniline being substituted for the dimethyl-aniline. Both compounds react with dilute mineral acids to form colourless salts.—On the generalisation of the Laplace-Abel integral, by M. G. **Mittag-Leffler**.—The discovery of fishes in the Devonian layer of the Pas-du-Calais, by M. J. **Gosselet**. The fossils found were of the genus Pteraspis, which is very common in the Old Red Sandstone in England and Scotland, but which has not been previously found in the Ardennes or in the eastern prolongations.—Remarks by M. C. de **Freycinet** on the experimental teaching of geometry.—Observations on the comet 1902 *b*, made with the 35 cm. equatorial of the Observatory of Lyons, by MM. J. **Guillaume** and G. le **Cadet**. The comet had the aspect of a very feeble nebulosity, which sometimes appeared to show a faint condensation. It was at the limit of visibility with the magnification of 150 employed for the measurements.—Perturbations which do not depend on the elongation, by M. Jean **Mascart**.—On slipping in fluids: a correction of a preceding note, by M. **Hadamard**.—Remarks on the liquidogenic theories of fluids, by M. E. **Mathias**. Of the two views of the phenomena at the critical point, the one regards the saturated state as univariant, the temperature determining the pressure as well as the density of the saturated fluid. This leaves certain facts unexplained, such as the anomalies between the densities of the liquid and saturated vapour in Natterer's tubes, the disappearance of the meniscus below the critical temperature, and the possible heterogeneity of the fluid above the critical point. These phenomena are explained by the theory of De Heen. The author shows that these two theories are not necessarily incompatible.—New researches on electric convection, by MM. H. **Pender** and V. **Cremieu**. The authors, working independently, have previously arrived at contradictory results on the magnetic effect of electric convection, and hence have decided to pursue the subject in collaboration. So far the experiments have given indecisive results, the effects being very irregular.—On the heat of combustion of phosphorus and on the phosphoric anhydrides, by M. H. **Giran**. The heat of combustion of yellow phosphorus has been determined by burning with compressed oxygen in the Mahler bomb, the results being about 3 per cent. higher than those currently accepted. From the heat of solution of the pentoxide obtained, it would appear to consist of the amorphous variety. Metaphosphoric acid is the only product on solution in water.—On some new acetylenic acids, by MM. Ch. **Moureu** and R. **Delange**. By acting upon acetylenes of the general formula $R—C \equiv C—H$ with sodium and then treating these with CO_2, the authors have prepared a number of acetylene acids of the fatty series, the more important physical properties of which are given.—Contribution to the study of the thio-acids of the formula R—CO—SH, by MM. V. **Auger** and M. **Billy**. The only method allowing of the production of true thio-acids is that of Kékulé, the saponification of esters with sodium hydrosulphide.—On para-ethyl-benzoic aldehyde, by M. H. **Fournier**. An unsuccessful attempt was made to prepare this aldehyde by the action of hydrogen chloride and carbon monoxide on ethyl-benzene in presence of aluminium chloride. It was obtained by Bouveault's method by the action of ethoxalyl chloride upon ethyl-benzene in presence of aluminium chloride, heating the resulting ester with aniline, and boiling the derivative obtained with dilute sulphuric acid.—A method for estimating glycerol in the blood, by M. Maurice **Nicloux**. After precipitating and separating the albuminoid matters of the blood, the glycerol is distilled in a vacuum at 100° C., and estimated by potassium bichromate and sulphuric acid. A series of test analyses is given, the mean error being about 5 per cent., or approximately that inherent in the bichromate method.—On the structure of the tracheal cell of the gad-fly, and on the origin of the ergastoplasmic formations, by MM. A. **Conte** and C. **Vaney**.—The manometric ear, by M. Pierre **Bonnier**. A criticism of the results of experiments recently published by M. Marage.—The nervous ganglia of the posterior roots belonging to the system of the great sympathetic, by M. N. Alberto **Barbieri**.

—The dinosaurs of Belgium, by M. Louis **Dollo.**—A biological study of parasitism; *Ustilago Maydis*, by M. Julien **Ray.** On the geology of the Montagne des Français (Madagascar), by M. Paul **Lemoine.**—On subterranean waters and the disappearance of springs, by M. E. A. **Martel.**—On geographical explorations carried out in the Tchad region, by M. **Destenave.**

DIARY OF SOCIETIES.

THURSDAY, March 12.

Royal Society, at 4.30.—On the Histology of *Uredo dispersa*, Erikks., and the "*Mycoplasm*" Hypothesis: Prof. Marshall Ward, F.R.S.—The Statolith Theory of Geotropism: F. Darwin, F.R.S.—A Study of a Unicellular Green Alga, occurring in Polluted Water, with Especial Reference to its Nitrogenous Metabolism: Miss H. Chick.—A Comparative Study of the Grey and White Matter of the Motor Cell Groups and of the Spinal Accessory Nerve in the Spinal Cord of the Porpoise (*Phocaena communis*): Dr. D. Hepburn and Dr. D. Waterston.—The Oestrous Cycle and the Formation of the Corpus Luteum in the Sheep: F. H. A. Marshall.—On the Culture of the Nitroso-bacterium: H. S. Fremlin.—Upon the Immunising Effects of the Intracellular Contents of the Typhoid Bacillus as Obtained by the Disintegration of the Organism at the Temperature of Liquid Air: Dr. A. Macfadyen.

Royal Institution, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

Institution of Electrical Engineers, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms (abstract): M. B. Field.

Society of Arts, at 4.30.—The Currency Policy of India: J. Barr Robertson.

Mathematical Society, at 5.30.—On the Convergence of Certain Multiple Series: G. H. Hardy.—On the Representation of a Group of Finite Order as an Irreducible Group of Linear Substitutions and the Direct Establishment of the Relations between the Group-Characteristics: Prof. W. Burnside.—Approximate Calculation of the Periods of Vibration of a Circular Plate: Prof. H. Lamb.—Mathematical Notes: Dr. H. F. Baker.—Note on a Point in Hilbert's Grundlagen der Geometrie: E. T. Dixon.—On Surfaces which have Assigned Families of Curves as their Lines of Curvature: Prof. A. R. Forsyth.—Extension of Two Theorems on Covariants: J. H. Grace.—On Certain Sequences for Determining the *n*th Root of a Rational Number: S. M. Jacob.

FRIDAY, March 13.

Royal Institution, at 9.—Character Reading from External Signs: Prof Karl Pearson, F.R.S.

Physical Society, at 5.—On the Interpretation of Milne Seismograms: Dr. Farr.—A Potentiometer for Thermocouple Measurements: Dr. R. A. Lehfeldt.—A Direct-Reading Potentiometer for Thermoelectric Work: Dr. J. A. Harker.—The Measurement of Small Resistances: A. Campbell.—A Resistance Comparator: Dr. R. A. Lehfeldt.

Malacological Society, at 8.—Further Description of the Animal of *Damayantia carinata*, Collinge: Lieut.-Col. H. H. Godwin-Austen, F.R.S.—Note on the Generic Name Buliminus: B. B. Woodward.—Notes on Pleistocene Non-marine Mollusca from Portland Bill; and on Holocene Non-marine Mollusca from Wilts, Dorset, Cambridgeshire and Folkestone: R. Ashington Bullen.—On the Occurrence of *Neritina Grateloupiana*, Fér., in the Pleistocene at Swanscomb: A. S. Kennard and B. B. Woodward.

Institution of Civil Engineers, at 8.—Reconstruction of Midland Railway Bridge No. 27, over the River Trent: A. R. Langton.

Royal Astronomical Society, at 5.—On the Desirability of a Re-investigation of Problems growing out of the Mean Motion of the Moon: Prof S Newcomb.—A Proposed Southern Belt of Latitude Stations: Prof. S. C. Chandler.—On three of Sir W. Herschel's Observed Nebulous Regions in Orion: Prof. Max Wolf.—On the Period and Light Curve of 7514 *UV* Cygni: A. Stanley Williams.—On the Nebula *h* 2302 Cassiopeiæ; the Region surrounding H II 457 Eridani and H III. 558 Aquarii: Dr. Isaac Roberts.—A Series of Photographs of Nebulæ, &c., taken by Mr. Ritchey at the Yerkes Observatory will be Exhibited.

SATURDAY, March 14.

Royal Institution, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY, March 16.

Society of Arts, at 8.—Hertzian Wave Telegraphy in Theory and Practice: Prof. J. A. Fleming, F.R.S.

Society of Chemical Industry, at 8.—The Standardisation of Analytical Methods: H. Droop Richmond.—The Standardisation of Commercial Methods of Analysis, especially those applied to Brewing Materials: Arthur R. Ling.

TUESDAY, March 17.

Royal Institution, at 5.—Great Problems in Astronomy: Sir Robert Ball.

Zoological Society, at 8.30.—Observations and Experiments on Japanese Long-Tailed Fowls: J. T. Cunningham.—On some Nudibranchs from East Africa and Zanzibar. No. II.: Sir Charles Eliot, K.C.M.G.—Contributions to the Osteology of Birds. Part VI. *Cuculiformes*: W. P. Pycraft.

Society of Arts, at 4.30.—Artistic Fans: Miss Hannah Falcke

Royal Statistical Society, at 5.—Statistics of Italy: Bolton King.

Institution of Civil Engineers, at 8.—*Papers to be further discussed*:—Recent Irrigation in the Punjab: S. Preston.—The Irrigation Weir across the Bhadar River, Kathiawar: J. J. B. Benson.—*Paper to be read, time permitting*:—The Protection Works of the Kaiser-i-Hind Bridge over the River Sutlej, near Ferozepur: Amyas Morse.

WEDNESDAY, March 18.

Royal Microscopical Society, at 8.—The Helmholtz Theory of the Microscope: J. W. Gordon.

Society of Arts, at 8.—New Aspects of Life Assurance: William Schooling.

Chemical Society, at 5.30.—(1) Essential Oil of Hops: (2) On a Compound of Dextrose with Hydroxide of Aluminium: A. C. Chapman.—Action of Phosphorus Haloids on Dihydroresorcins. Part II. Dihydroresorcin: A. W. Crossley, and P. Haas.—On the Constitution of Cotarnine: J. J. Dobbie. A. Lauder, and C. K. Tinkler.—Decomposition of Mercurous Nitrite by Heat: P. C. Ray and J. N. Seh.

Entomological Society, at 8.—An Entomological Excursion to Bejar, Central Spain: G. C Champion.—On Lepidoptera from the White Nile collected by Mr. W. L. S. Loat, with further Notes on Seasonal Dimorphism in Butterflies: Dr. Frederick A. Dixey.—*Hymenoptera aculeata* collected by the Rev. A. E. Eaton, in Madeira and Tenerife, in the Spring of 1902: E. Saunders, F R.S.

Royal Meteorological Society, at 7.30.—The Passage of Sound through the Atmosphere: C. V. Boys, F.R.S.

THURSDAY, March 19.

Royal Society, at 4.30.—*Probable Papers*:—On the Formation of Barrier Reefs and of the Different Types of Atolls: Prof. A. Agassiz, For. Mem. R.S.—On Central American Earthquakes, particularly the Earthquake of 1838: Admiral Sir John Dalrymple Hay, Bart, F.R.S.—On the Electrons of Radium: Sir William Crookes, F.R.S

Linnean Society, at 8.—On *Poa laxa* and *Poa stricta*, of our British Floras: G. Claridge Druce.—The Botany of the Ceylon Patanas. Part II. Anatomy of the Leaves: John Parkin and H. H. W. Pearson.

FRIDAY, March 20.

Royal Institution, at 9.—The Paths of Volition: Prof. E. A. Schäfer, F.R.S.

Epidemiological Society, at 8.30.—The Prevention of Diphtheria Outbreaks in Hospitals for Children: Dr. Louis Parkes.

Institution of Mechanical Engineers, at 8.—A Premium System applied to Engineering Workshops: James Rowan.

SATURDAY, March 21.

Royal Institution, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

CONTENTS.

THURSDAY, MARCH 19, 1903.

A DUTCH PRIME MINISTER ON ECONOMICS.

Principles of Economics. By Dr. N. G. Pierson. Translated from the Dutch by A. A. Wotzel. Vol. i. Pp. xxx + 604. (London: Macmillan and Co., Ltd., 1902.) Price 10s. net.

DR. PIERSON'S book in the original Dutch has become widely known in this country, in spite of the obstacle of language. So much was due to the author on account of his peculiar position as a banker and man of business, as well as a statesman, entitling him to a special hearing as an economist. But the intrinsic qualities of the book have also been such as to attract an appreciative audience. It is an account very largely at first hand of the writer's own experiences in applying economic principles to the daily practice of banking business, and later on to the problems of economics which came before him as Prime Minister of his State. We are glad, therefore, to see the present translation into English, which is extremely well done, and will contribute greatly to extend Dr. Pierson's reputation in this country, well known as he already is.

Dr. Pierson informs us in his introduction that "economics may be described as the science which teaches us what rules mankind should observe in order to advance in material prosperity"; and this appears to be an excellent definition if the qualification be added to the word "rules," that they are to be general rules applicable to every description of industry and business, and not the special rules of each industry by itself. There are many rules, for instance, to be studied and applied by the farmer or banker, each in his own profession, in order to advance in material prosperity, which are no part of the more general economic rules that equally require study. The qualification should also be added, perhaps, that the rules referred to are largely rules to be followed by public men in directing the action of the State where it comes in contact with business—in regulating taxation, monopolies, currency, and any other matters that seem properly reserved for the action of the community as a whole in the conduct of common business. Nothing much, however, turns upon definitions of this kind. In economic books the important thing always is to be in contact with reality, and in this respect Dr. Pierson's book is not lacking. Leading business men and politicians are practically taught how to advance in material prosperity by observing the nature and conditions of exchanges. It is, in fact, thoroughly scientific.

Dr. Pierson's conclusion that the science is mainly deductive may also be accepted. There is often confusion in discussions as to the limits and functions of political economy between the phrases deductive and theoretical. Because it is so much deductive, political economy is often said, with reproach, to be a theoretical study only, and its professors are nicknamed theorists. But the deductions, nevertheless, may be from facts of a general kind, and are thus as legitimate as the propositions of the multiplication table. Dr. Pierson, accordingly, is fully justified in his remark. It should be understood, moreover, that as to large provinces of the study, especially the province of the money market, Dr. Pierson is mainly a describer, and not a theorist, or if, as sometimes happens, he appears to theorise and is not so much a describer, he theorises as Ricardo did—that is, by giving as a theory a description of what business men invariably do under the conditions stated.

We would especially refer students to the closing chapter of the book on foreign exchanges as of singular excellence, containing, perhaps, the fullest exposition ever given of the various puzzles as to balance of trade, balance of payments, and balance of indebtedness, as well as those respecting high and low rates of discount, on which so many people make shipwreck. There has been no more complete exposition of the subject, and what Dr. Pierson has to say may well be compared with Mr. (now Lord) Goschen's "Theory of the Foreign Exchanges" and Mr. Bagehot's "Lombard Street." We are not quite sure we can agree with him throughout as to the regulation of currencies, a subject which we should have liked to see discussed from the point of view of no regulation at all, instead of from the Continental point of view, which accepts regulation as a matter of course; but this criticism in no way diminishes our sense of the value of the discussion itself.

The chapters on the principal monetary systems and on banking in the principal countries are equally complete and interesting, especially when the student remembers that Dr. Pierson himself has had to deal with the business in his capacity as President of the Netherlands Bank and Prime Minister of the Netherlands.

The student will find it both interesting and amusing, we believe, that Dr. Pierson, after an elaborate description of the fall in silver and the ineffectual attempts of bimetallic agitators in the United States and elsewhere to restore the ratio, goes on to describe with effect various practical reasons for believing that bimetallism is no longer a possibility, and then adds a regret that this should be the case, when the opinion had become very general among experts—he himself holding the same opinion—that bimetallism is really possible if only all nations would consent to try it at the same time! We cannot but think this expression of opinion the one symptom of imperfection in the book. The practical reasons against bimetallism—universal or otherwise—are, in fact, found to be based on the mathematical reasoning of Locke, who demonstrated that, as there could be no fixed price between gold and silver, there could be no coexistence of the two as standard money and no joint circulation of the two at any time at a fixed price. But this is a small blemish in a book all but perfect in other respects, which ought to be in the hands of every economic student.

R. G.

PURIFICATION AND DISPOSAL OF SEWAGE.

Sewage Works Analyses. By Gilbert J. Fowler, M.Sc. (Vict.), F.I.C. Pp. vi+130. (Westminster: King and Son; New York: John Wiley and Sons, 1902.)

THE thanks of all who are directly interested in the disposal and purification of sewage—a rapidly increasing number—are due to Mr. Fowler for his excellent little manual. In his preface he says:—

"The following book has been written in response to several requests for an account of the methods of analysis in use in the laboratory of the Manchester Corporation Sewage Works.

"Through the courtesy of Mr. F. Scudder, the author has been able to include descriptions of some of the more important processes employed in the laboratory of the Mersey and Irwell Joint Committee.

"In general it may be said that the Joint Committee's methods are designed for cases where samples from different works have to be critically examined, the Manchester methods for the analysis of a large number of samples of sewage and effluents of the same general character.

"The successful application of modern bacterial processes will necessitate careful chemical control. It is hoped, therefore, that the following book will prove of use to the increasing number of chemists who are interested in the scientific treatment of sewage.

"The methods here described are such as a considerable experience has shown to be capable of being rapidly executed, and of giving results of an accuracy amply sufficient for practical requirements."

The book opens with a very brief description of the general principles of sewage purification, divided under the two headings:—(*a*) mechanical or disposal processes; (*b*) biological or purification processes, with regard to the second of which the author writes:—

"The changes which take place in all these biological processes are much more complex than those which are effected by any of the mechanical or disposal methods in class (*a*), and chemical control is absolutely necessary if they are to be maintained in their greatest efficiency."

The few pages which are devoted to this section might, we think, be extended with advantage in a future edition. Even allowing for the fact that the work is one intended to deal with analytical methods, a somewhat fuller summary—so far as present knowledge goes—of the changes which take place in septic tanks and bacterial filters, from the pen of one who has made a special study of those points, could not fail to be of direct benefit to the laboratory worker. Such a summary would almost certainly stimulate his interest in the methods with which the book subsequently deals.

After a short discussion on the gauging of sewage flow and upon methods of sampling, the latter a point on which it is difficult to lay too much stress, the author goes on (p. 11) to indicate what in his opinion are the chief chemical data required to determine the amount of impurity in sewage and effluent, the working out of these data being given later in the book. A further portion of the chapter is devoted to the "method of recording results," and here we might add that it is very desirable that some uniform system of records should be adopted throughout the country. The chapter closes with a section on the degree of purity necessary in an effluent, some of the provisional standards adopted by different Rivers' Boards being quoted. This question of standards is too large and thorny a one to be entered into within the limits of a short review, but the author rightly emphasises the point that an effluent should be purified to such a degree that it will not take up oxygen from the water of any stream into which it may flow.

In chapter ii. the well-known "oxygen absorbed" test is discussed at length, and full directions are given for carrying it out; one advantage of this test is that a simple modification of the "three minutes'" test can be applied by any intelligent workman. The chapter concludes with a description of Mr. Scudder's "incubator test," which is now so widely employed.

In the section dealing with the determination of free and "albuminoid" ammonia, the methods followed both in the Manchester Corporation and in the Mersey and Irwell laboratories are detailed at length (p. 44 *et seq.*). The accurate estimation of albuminoid ammonia in sewage effluents is not so simple as it is usually assumed to be, and, as it is a point of much importance, it would be well if some more or less uniform system of procedure could be generally followed.

The determination of nitrates (p. 61) is one of the most important of all estimations in a sewage effluent. The Gladstone-Tribe method (reduction with the copper-zinc couple), which Mr. Fowler himself uses, is probably the most accurate of any, but it has the disadvantage of requiring twelve to twenty-four hours for completion. It is to be noted here that the author recommends the preliminary expulsion of any excess of ammonia present by distillation with steam—a plan which is perhaps better than by simple boiling in an open flask. At the same time a loss of nitrogen is apt to occur here if nitrites are present in any quantity—at least, this is the case with the boiling procedure; it can, however, be prevented, as has been shown by P. Frankland, by the previous addition of a small quantity of some alkali.

In detailing several processes for the determination of dissolved oxygen in effluents, a reference to Winkler's chloride of manganese method, as modified by Rideal, might with advantage have been included.

On pp. 82-85, the determination of the *rate of absorption* of dissolved oxygen by an effluent—perhaps the most important of all the chemical tests—is explained, and various examples are cited.

In the remaining sections of the book there are to be found such important items as the determination of solids in suspension, of supreme consequence in the case of a tank liquor and of an effluent which passes directly into a stream; the collection and examination of the gases evolved from septic tanks and in the interior of filter beds, &c. But enough has already been said to show the comprehensive and exact character of this little volume.

Before closing, two omissions may perhaps be referred to, viz. (1) in any book dealing with the analysis of sewages and effluents, one might naturally expect a reference to be made to the work of the late Sir E. Frankland, Dupré and Adeney; and (2) it is

frequently desirable to make a determination of the *total* nitrogen in an effluent, if only as a check on the estimation of the nitrogen in its various forms of ammonia, nitrate, &c. We would, therefore, suggest these points for a future edition, which will no doubt shortly be called for.

Mr. Fowler is to be congratulated on having compressed a great deal of valuable information within short compass, and at the same time in a clear and pleasant style. G. M.

ANOTHER TEXT-BOOK OF ZOOLOGY.

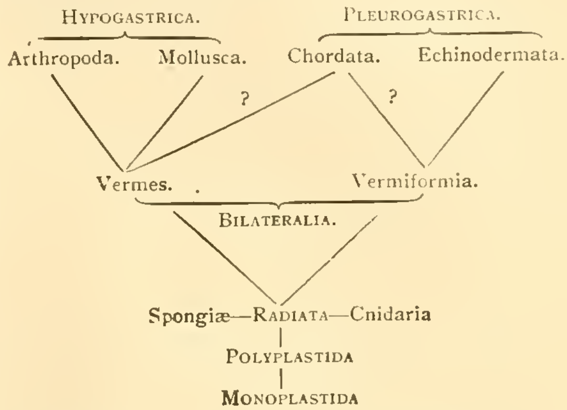
Lehrbuch der Zoologie. By Dr. Alexander Goette, Professor of Zoology in the University of Strassburg. Pp. xii + 504; 512 figs. (Leipzig: Engelmann, 1902.) Price 12*s.* net.

WHAT the illustrious and experienced author proposes in his preface is a text-book for University students—presumed to be serious—a scientific work, a synthetic presentation of the results of analysis, an evolutionist outlook, an exposition in which structure, function, and relationships are to be considered essentially "als Erfolge einer geschichtlichen Wandlung." This is a noble ideal of a text-book, and to say that the outcome falls short of it is only to say that Dr. Goette is human—a busy investigator and teacher, with much more urgent tasks than writing text-books.

The volume begins with a commendably terse introduction of twenty-five pages, in which the author discusses with clearness the basis of a genetic classification; the concepts of analogy, homology, and homoplasy ("Homoidie"); the essential facts regarding cells and protoplasm; the progress of modern zoology; and the evolution theory. He lays emphasis on the intra-organismal causes of the constitutional variations on which natural selection plays the part of the pruning-knife. It is a lucid introduction, but probably too terse and abstract to rivet the attention of the University student, who desires a wealth of concrete illustration and a non-dogmatic mode of argument. In a subsequent chapter, introductory to the Metazoa or Polyplastids, Goette discusses the beginnings of "body-forming" and the associated tax of "natural death," the differentiation of tissues and organs, and the nature of sexual reproduction.

The author's method is to follow the systematic order, and we wish to refer to his classification, which seems ultra-conservative. Thus in the phylum of Monoplastids or Protozoa, he recognises two classes—the Rhizopods and the Infusorians. The Sporozoa appear as an appendage of the Rhizopods and the Suctoria as an order of Ciliata. We do not find that Goette gives any reasons for this maltreatment. In the next section, which deals with radially symmetrical animals ("Radiata"), the Sponges are discussed in an elementary fashion in four pages, and classified as horny, flinty, and calcareous—again without a hint of phylogenetic relationships; and while the Cnidaria or Cœlenterates are more fully discussed, divided into Hydrozoa and Scyphozoa (including Ctenophora), we get no picture of the possible evolution of the phylum. We have the same comment to make throughout, that although the treatment of the various classes and subclasses is clear and terse, there is little of that evolutionary discussion of the phyletic affinities which the preface led us to expect.

Goette divides bilaterally symmetrical animals into Hypogastrica and Pleurogastrica, the former including Vermes, Arthropoda and Mollusca, the latter including Vermiformia, Echinoderma and Chordata. His scheme is as follows:—



In Hypogastrica, the gastrula is elongated in the direction of its transverse axis, and its slit-like blastopore (prostoma) lies ventrally, and coincides anteriorly with the formation of the mouth; in Pleurogastrica the gastrula is elongated in the direction of its longitudinal axis, and the compressed prostoma usually becomes the anus, the mouth being a new formation anteriorly.

In the phylum Vermes, the Nemerteans are ranked, without argument, as a third order of Turbellaria; and the Nematodes are placed as a class beside Annelids in the subphylum Cœlhelminthes, though the cavity of the nematode body is spoken of distinctly enough as a pseudocœl, not a cœlom. Echiurids and Sipunculids are slumped together as Gephyrea, and the appendix to the Vermes includes (1) Bryozoa, (2) Rotifers, and (3) Brachiopods.

There is less eccentricity in the treatment of Arthropods and Molluscs, which receive a full and yet admirably terse discussion. The Trilobites are ranked as an appendix to Entomostraca, the Eurypterids and King-Crabs as a third subclass of Crustacea. The author's Vermiformia, with which the pleurogastric group of phyla begins, include Chætognatha and Enteropneusta, with Cephalodiscus and Rhabdopleura appended to the latter. After a clear account of the Echinoderma, Prof. Goette passes to chordate animals: he dignifies Ascidiæ, Appendiculariæ and Salpæ as separate classes of the subphylum Tunicata; the Lancelets represent the second subphylum, and Vertebrata the third. Cyclostomes are ranked as a class of Pisces, but distinguished sharply from

the "Euichthyes," which include Plagiostomes, Teleostomes, and Dipnoi. The order of Ganoidei is still allowed to survive, and Polypterus reposes beside Lepidosteus and Amia. In the treatment of Reptiles a recognition of the phylogenetic relations is practically missed by insufficient notice of the extinct classes, and Archæopteryx (der zwar kein wirklicher Vogel war) is discussed under Reptiles rather than under Birds. Placental mammals are dealt with in four groups:—Unguiculata (the Rodents come somewhat quaintly between Chiroptera and Edentates), Ungulata, Natantia (Sirenia beside Cetacea), and Primates. The strongest part of the volume seems to us to be the general discussion of the structure of Vertebrata, but even here the author's extraordinary restraint lessens the interest of many of his paragraphs; we may refer, for instance, to what he says in regard to the thyroid and the thymus.

The figures have been designedly kept simple, but they are very clear and accurate. They are for the most part from original drawings, and many of them are fresh and interesting.

OUR BOOK SHELF.

The Analysis of Oils and Allied Substances. By A. C. Wright, M.A., B.Sc. Pp. xi + 241. (London: Crosby Lockwood and Son, 1903.) Price 9*s*. net.

THE book is not, nor does it profess to be, a manual for the oil specialist. As a work for the student who wishes to specialise and "as a laboratory guide for chemists who are not extensively engaged in oil analysis, or who have to deal with only a limited number of oils" (to use the words of the preface), it fills a decided want, and is evidently written by one who understands the requirements in such a case. The first chapter, on the occurrence and composition of oils, fats and waxes, may at first sight appear to be superfluous, but it deals systematically with so many substances that are unfamiliar to those relying only on the usual chemical text-books for their knowledge that it forms a really essential introduction to the subsequent chapters.

In the section on glycerin, a table of specific gravities of glycerin of different strengths is given; an error exists here in the specific gravity of 40 per cent. glycerin, 1·020 being evidently a misprint for 1·1020.

The chapter on the chemical properties of oils, fats and waxes from the analytical standpoint includes careful descriptions of the methods of obtaining the so-called constants; the "ether value" is called the "ester value"—a preferable term. An important comparison is given of Hubl's and Wijs's methods of determining iodine values.

A chapter which contains a somewhat extended description of the properties of the more important oils, &c., with the methods of their investigation, is one which is of especial use to those taking up the study of this subject, but it is doubtful how far the author is justified in saying a little, in a book of this character, on such a debated question as the estimation of beef-tallow in lard—one of the most difficult problems that the oil chemist can have put before him.

On the whole, the author appears to have succeeded in the task he has set himself, and the subject-matter is carefully brought up to date. References to original papers are numerous.

The book is very clearly printed, it is got up in very readable style, and the index appears to have been carefully compiled with a view to completeness.

Opere di Galileo Ferraris. Vol. i. Pp. xxviii + 492. (Milan: Ulrico Hoepli, 1902.)

THE Italian Electrotechnical Association decided to commemorate its founder, Galileo Ferraris, by publishing his collected works in three volumes, of which the present contains those papers which have the most intimate bearing on electrotechnics. The first, a paper on the use of the compass for galvanometric measurements, was written while Ferraris was assistant lecturer at Turin under Prof. Codazza, the second being his thesis for the doctorate, on the propagation of electricity in homogeneous solids, a mathematical work based on methods similar to those employed by Kirchhoff. The invention of the telephone by Graham Bell, about the year 1877, attracted the attention of Ferraris, who was not slow to read a paper at the Turin Society of Engineers, and to find in the new instrument a means of testing Helmholtz's theorem, according to which the timbre of a sound does not depend on the phases of its components. Another paper is on the intensity of the currents in the telephone. His two elegant theorems on the distribution of constant currents, published in 1879, follow. The introduction of secondary generators or transformers, in 1884, paved the way for his classical memoirs on the Gaulard and Gibbs transformer, on the difference of phase and dissipation of energy in transformers, on some results of experiments with the Ganz transformer, invented by Zipernowsky, Déri, and Bláthy, and an interesting correspondence with Dr. Hopkinson. The alternating current motor forms the subject of the next two papers, and the volume concludes with his treatise on the geometry of vector fields, which was published after his death. This paper affords an example of the spirit in which Ferraris devoted himself to science. His successes as an applied electrician, so far from drawing him aside from theoretical work, seem to have stimulated him to advocate the pursuit of research for its scientific value. From the introductory sketch of his work by Prof. Guido Grassi, we quote the following words:—"Whoever, in scientific researches, always has applications in view never discovers any." Again, at the second conference on electric lighting, in referring to the patient workers that had established the conditions for resolving economically the problem of illumination, Ferraris remarked:—"These men never thought of applications, *and it is for this reason that they discovered them;* they performed the part most important for applications, they provided the applicable things."

A Text-book of Field Astronomy for Engineers. By G. C. Comstock. Pp. x + 202. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 10*s*. 6*d*.

THIS text-book is designed for the considerable class of technical students who need to make practical applications of the methods of spherical astronomy, but cannot devote to the subject the time necessary for a course such as befits those who wish to study astronomy as a science. Teachers who have to undertake the instruction of such students will study with interest the course which Prof. Comstock has adopted after an experience extending over many years, more especially as no attempt is made to reduce the work to mere rule-of-thumb processes. The introductory chapters include the necessary formulæ for the solution of spherical triangles, hints on the orderly arrangement of computations, definitions of coordinates, and a short account of the various corrections to observed data. The methods of observation are classified as rough, approximate and precise according to the degree of accuracy required, and this excellent arrangement not only simplifies the task of the student, but indicates how time may often be saved by avoiding the more refined

processes when a comparatively rough result is sufficient for the purpose in view. Some of the processes described have not usually been introduced into elementary treatises, but all that are given have been found by the author to be well adapted for students. It is not quite clear why the description of instruments is postponed to the part dealing with accurate determinations, seeing that their use is assumed in earlier chapters, but otherwise the sequence is all that can be desired. Some of the "forms" for computation do not seem to be the best that could be devised for beginners, though they are doubtless well adapted to trained workers, and we think they could be made more self-explanatory with advantage to the student. The book deals very completely with the astronomical work involved in surveying, and anyone who masters its contents will obtain a thoroughly sound knowledge of the subject.

A New Student's Atlas of English History. By Emil Reich, Doctor Juris. Pp. vii + 55 maps. (London: Macmillan and Co., Ltd.) Price 10*s.* 6*d.*

THIS small and handy atlas will be found of use in the higher forms of schools, for the modern specialising sixth form boy who is going to add to the number of open scholarships which his school can advertise to the world, more especially. Nor will the aspirant after a "first in modern history" find Dr. Reich's book of small use to him by any means. It contains many points that will not be found elsewhere; for instance, the historical summaries facing the maps in most cases will prove very handy. The maps themselves are good and are up-to-date; the latest partition of Africa is given, and the Transvaal and Orange Colony are as red as Natal. We may, perhaps, object to Egypt being described in brackets as "(Turkish)" on map 48; if it is not British, it is Egyptian; the shadowy and hardly even nominal overlordship of Turkey is hardly worth commemoration any longer. Also, there are not enough maps; what there are are so good that we should like more.

As is perhaps natural, however, in a German author, there is a suspicion of pedantry about the book. In the preface there is much talk about "pædagogy" (though "pedagogue" in English is a term of abuse, and the Greek παιδαγωγὸς was a sort of male nursemaid!), and it is obviously directed rather to the address of the schoolmaster than of his pupil. Personally, we think that such a preface should be written for the information of the boy who is going to read the book. But this is a matter of opinion.

The Rational Memory. By W. H. Groves. Pp. vi + 115. (Gloucester, Va.: W. H. Groves, n.d.)

FEW could read this useful little book of 115 pages without benefit. The author does not claim originality, but has selected the principles and facts of recognised importance from other works on memory. The author draws special attention to the fact that one man may have a good memory for certain things, and yet be very deficient in remembering others. This fact, though so well known, is constantly overlooked by writers on memory. They can themselves remember, through the possession of some well-developed faculty, and therefore invent a system based on this fact, whereas the majority of persons might find greater difficulty in remembering through the system than through the ordinary method. The author devotes four chapters to the consideration of concentration and observation. There is a very instructive chapter on the necessity of reviewing the knowledge we possess, so as to have it available at any given moment. As we remember entirely from single impressions, it is of the greatest practical importance that when we receive a new impression the previous one be revived. A simple illustration will make this clear: A man may meet another three separate times without remembering that he has met him before; he might subsequently remember that he had met the man on any one of the three occasions, but the remembrance would not be nearly so vivid as if he had recognised his acquaintance each time they met. The chapter on the subconscious or subjective memory contains many statements which will not admit of proof. As a matter of fact, all memory is subconscious; everything is remembered, and may, in favourable circumstances, be brought before the mind. There are some curious errors which the author would do well to correct in another edition, such, for instance, as the use of the word "mneumonics," which occurs repeatedly for "mnemonics," and the reference to Mr. Gladstone as Sir Wm. Gladstone.

Real Things in Nature. A Reading Book of Science for American Boys and Girls. By Edward S. Holden, Sc.D., LL.D., Librarian of the U.S. Military Academy, West Point. Pp. xxxviii + 443. (New York: The Macmillan Company, 1903.) Price 3*s.* 6*d.*

THE subtitle of this book is somewhat misleading, because it may give the idea that Dr. Holden imagines it is possible to teach science by reading lessons alone. An examination of the contents of the volume shows this is by no means the case, for Dr. Holden continually instructs his reader to try experiments bearing upon the statements made in the book. The scope of the volume is very wide, readings being given in astronomy, the various branches of physics, meteorology, chemistry, geology, zoology, botany, human physiology, and the numerous subjects included under the early history of mankind. The book is well and profusely illustrated; it contains a full table of contents, but no index, an omission which rather interferes with the usefulness of the book as a work of reference for pupils.

Castology: a View of the Oolite Period and Earliest Man. By J. Craven Thomas. Pp. 20. (Bromley: Kentish District Times Co., Ltd.)

THIS purports to be a paper read before "The Bromley Naturalist (*sic*) Society" in November, 1902, and we can only marvel. Had it been written two or three hundred years ago we should not have been surprised, but for anyone in the twentieth century to advance seriously the views expressed by Mr. Craven Thomas is astounding. His "science of castology" appears to be the contemplation (we cannot say study) of flint-casts which he regards as belonging to the Oolite period! But it will be sufficient to quote one paragraph from his pamphlet:—"Fossil flint is that which is composed of petrified organisms, with or without a certain amount of integument, such as leaves, branches of trees, fruit, birds, beasts, fishes, and broken parts of man"!!

The New Forest. Its Traditions, Inhabitants, and Customs. By Rose C. de Crespigny and Horace Hutchinson. Pp. viii + 293. (London: John Murray, 1903.) Price 2*s.* 6*d.* net.

THIS pleasantly written book appeals both to lovers of the New Forest and to those who have yet to make the acquaintance of this vast woodland region. Readers who have themselves explored the recesses and solitudes of the forest will be impressed by the wide knowledge of the beauties of this part of Hampshire possessed by the authors; and those who have not yet strolled through the leafy glades of, say, Mark Ash will, after reading the book, be anxious to spend a few pleasant days wandering in the forest.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Effects of the Gale of February 26.

THIS district, and so far as I know a large part of Ireland, was in the early hours of the morning of February 26 swept over by a gale of exceptional violence. The maximum occurred between 1h. and 2h. 30m. a.m.

The destruction of trees has far exceeded that caused by any gale within my memory. Nothing at all like it has occurred here since the celebrated storm of 1839. The damage, I should say, certainly exceeds the total during the intervening interval of sixty-three years. No kind of tree has escaped.

What has struck me most is the strong evidence of the fact that it is not the absolute pressure of the wind which does the damage, but the unsteadiness of the pressure, giving rise to oscillating motion which, when the periodicity of the gusts happens to be nearly the same as that of the tree, causes it to succumb.

Owing to the immense number of the prostrate trees on the present occasion, there are exceptional opportunities for testing this. In numerous cases plantations have been practically levelled, but of the few survivors the greater number are usually found on the outside, principally on the weather side.

Single trees standing alone in fields have usually escaped. Of groups of three or four it is rarely the case that that on the weather side has been the one to suffer. I rather think that where the row lay in the direction of the wind there have been more casualties than where it was at right angles to it, but I have not been able to satisfy myself as to this. There are, however, many cases of trees lying nearly parallel to the fence.

The trees in nearly every case lie in a north-east direction. A very few are in various degrees of orientation. The gale seems to have been most unequal in its action. Lanes some forty yards wide, which can be traced for several hundred yards, have been swept down, and on each side, perhaps for 200 yards, little or no indication of the tempest is perceptible. There seems to be no evidence of any rotation of the blast in these lanes.

I think that it is clearly proved that in the case of trees, and probably more or less of artificial structures, unsteadiness of blast is very largely responsible for damage, and that recorded velocity and mean pressure form very fallacious guides as to force to be resisted.

It has been remarked to me by several people that trees in exposed situations, even upon the tops of hills, have escaped, while others have been swept away wholesale in hollows where they were entirely shielded from the direct action of the blast. ROSSE.

Birr Castle, March 14.

Ambidexterity.

IN the "Notes" of NATURE of March 12 you mention an association proposing to teach writing with both hands by the method of upright penmanship. This is quite intelligible, but when it is said that the child by this means will acquire left-handed skill in all other manipulations, this cannot be correct. Left-handedness means that the left hand can be used equally well with the right; this is true, but not in the same way. The course of the cricket ball in a left-handed bowler is not the usual one. When a surgeon is left-handed it is not to enable him to do with his left exactly the same thing as with the right, but something different. After making an incision in the eye with his right hand, he takes the knife in his left to complete what he requires, without altering his position or turning the patient round. A left-handed waiter, after removing the limbs of the chicken on one side, changes the knife and fork to the other hands, and does the same on the other side. It only wants a moment's consideration to see that if the arms are turned round one goes in the right direction and the other in the left, so that if the right hand is used in turning a screw to the right, as screws are all made, a corresponding movement with the left would turn it in the opposite direction. As left-handed screws are not usually made, a left-handed man has to use a different and inferior set of muscles, and works with a disadvantage. In the same way ordinary handwriting cannot be copied by the corresponding muscular and nerve apparatus on the left side; it is done by a totally different apparatus after much time and trouble. It is much easier to use the corresponding set of muscles, but then this produces backward or mirror writing. The only movements common to the two sides must be near the median line. If the corresponding muscular and nerve apparatus be used in both arms, the result is equally good, but it is not the same, as in writing or turning a screw. If one hand imitates the exact movements of the other, it is done by another apparatus and at a disadvantage, as with a child learning the scale and using different fingers for similar notes. There is, therefore, no such thing as ambidexterity, unless, indeed, it is used in another sense, as in the violin player, where he educates each hand for its own particular object. SAMUEL WILKS.

Mendel's Principles of Heredity in Mice.

THE experiments respecting heredity in mice conducted by Mr. Darbishire in the Oxford Laboratory at Prof. Weldon's suggestion, and described in *Biometrika*, ii., parts i. and ii., are of exceptional interest. As the fruitful development of these and similar experiments depends on a true interpretation of the facts so far reached, I offer a few words in supplement to the conclusions deduced by the author.

By crossing Japanese waltzing mice having pale fawn and white coats and pink eyes with ordinary white pink-eyed mice, 154 offspring were produced, of which 137 were grey and white, 1 was grey, 7 were yellow and whitish, 9 black and white or whitish. The colour-patches showed decided variations in amount and in tint. A fact of extraordinary physiological significance (omitted from the preliminary account) is that though the eyes of both parent-forms were pink, the cross-breds *without exception had dark eyes*, a result which, though to some extent paralleled by certain plant cases, is probably as yet unique among animals, at least in degree.

The cross-breds bred *inter se* gave 66 mice, of which 13 were pink-eyed albinos, 17 were pink-eyed with more or less colour in the coat, and 36 were dark-eyed, some (presumably all) having colour in their coats. Bred with albinos the cross-breds gave 111 pink-eyed albinos, and 94 with dark eyes and some colour in their coats. The coat-colour phenomena, though exceedingly important, are too complex for consideration in a few lines. The evidence also, as yet, is in some respects insufficient, but did space permit I should be glad to discuss these facts as far as they go. As to eye-colour, the phenomena are simpler, and from them the following conclusion is drawn by the author:—

"The inheritance of eye-colour is not in accordance with Mendel's results. For since pink eyes occur in parti-coloured mice, the possession of pink eyes must, on Mendel's view, depend on a separate embryonic element from that which determines coat-colour. Pink eyes are, however, not 'dominant,' since the two pink-eyed parents of the first generation always produce dark-eyed young. For the same reason pink eyes are not 'recessive.' Yet although pink eyes disappear in the first generation (the result of crossing two pink-eyed parents) they reappear in the second; but a correlation is then established between coat-colour and eye-colour which is strong in the offspring of hybrids paired together, and at present perfect in the offspring of hybrids and albinos. The behaviour of eye-colour is thus in every respect discordant with Mendel's results."

The purpose of the allusion to "dominance" escapes me. In what circumstances could pink-eye be dominant, or recessive, to pink-eye? The reference to correlation is no less perplexing. The meaning might be clearer if we were told what offspring the writer would have expected if the inheritance *had* been "in accordance with Mendel's results." But a negative conclusion, however acceptable, supplies

imperfectly the place of a positive result. Let us see if a positive interpretation is compatible with the facts.

In face of so emphatic a declaration to the contrary, my opinion may seem over bold; yet I feel no hesitation in believing that the inheritance of eye-colour in these mice, so far as the record reaches, was strictly Mendelian. The first cross proves that when *in this case* an albino (pink-eye) gamete, G, meets a colour-bearing (pink-eye) gamete, G′, in fertilisation we must expect the resulting heterozygote, GG′, to be coloured in coat, with a *dark* eye. When these heterozygotes breed *inter se*, they will form on an average equal numbers of homozygotes, GG and G′G′, and of heterozygotes GG′ and G′G. Of these, the homozygotes will all have pink eyes, but while GG will have a white coat, G′G′ will have some colour in the coat. The heterozygotes, GG′ and G′G, will have dark eyes and some colour in their coats.

Treating GG′ and G′G as identical, we thus expect the ratio

1 GG : 1 G′G′ : 2 GG′.

Therefore the most probable distribution of the 66 mice is as follows:—

16·5 pink-eyed albinos : 16·5 pink-eyed with colour in coat : 33 dark-eyed with colour in coat,

and the experiments gave

13 pink-eyed albinos : 17 pink-eyed with colour in coat : 36 dark-eyed, (? all) with colour in coat.

Similarly, on crossing the hybrids with albinos, we expect equal numbers of GG and GG′. Therefore the most probable distribution of the 205 mice so produced is

102·5 pink-eyed albinos : 102·5 dark-eyed with colour in coat,

and the experiment gave

111 pink-eyed albinos : 94 dark-eyed with colour in coat.

Experiment agrees well with expectation. In what respect are they discordant?

The case is closely comparable with that found by Miss Saunders in Matthiola (Rep. to Evol. Cttee. of Roy. Soc., 1902), when a white hoary form crossed with a white glabrous form gave purple hoary offspring; and with the production by Kölreuter (confirmed by Gärtner, Naudin and Godron) of purple flowered hybrids by the union of two white flowered Daturas, *D. ferox* and *D. laevis*. *Why* in these cases the heterozygotes are atavistic we do not know, but the problem need not be insoluble.

Anyone conversant with Mendelian phenomena can now predict the eye-colour of the future offspring of the various unions with approximate accuracy. Pending further experiments, we cannot predict the particular colours which will appear in the coats, and for various reasons we should perhaps be cautious in declaring that *all* the dark-eyed mice must show colour in their coats.

From incidental comparisons of these new facts with the simpler results of von Guaita an inexperienced reader might suppose that the two sets of experiments had been comparable and had given discrepant results. It would have prevented misconception if the author had stated that while the waltzing mice he used were pale fawn and white with pink eyes, von Guaita's were *black and white with dark eyes*. It is a feature of the Mendelian view of heredity that different specific results may be expected when different specific materials are introduced. W. Bateson.

Grantchester, Cambridge, March 11.

University Education in the United Kingdom and Germany.

With reference to the admirable article on "The University in the Modern State" which you published in your issue of March 12, may I point out that the figures you give deal only with university education in Germany in arts, pure science, law, medicine, &c.; they do not include the very large expenditure on technical education of university rank. Both in that country and in the United States such education is given in technical institutions existing side by side with universities, but free from ordinary academic control.

Were these figures added, the comparison you make between the sums devoted to higher education in this country and in Germany would be still more striking. For—to take a single case—side by side with the well-endowed University of Berlin, there is the Technical High School at Charlottenburg, which is one of the finest technical institutions in the whole world, liberally supported by the State, and, notwithstanding the jealous protests of the Prussian universities, wisely authorised by the German Emperor to grant degrees in the main branches of technical knowledge.

J. Wertheimer.

Merchant Venturers' Technical College, Bristol, March 16.

[The series of articles referred to of set purpose deals with universities only.—Ed.]

Hygrometric Determinations.

During the past week I have made some determinations with regard to the humidity of the atmosphere at this place, and the results, which show a very rapid change, are, if not perhaps unusual for our climate, certainly somewhat striking.

The tests were made with dew point instruments, and I append the figures deduced from my determinations on four days.

	(a) Temperature of atmosphere.	(b) Dew point.	(c) Elastic force vapour, according to Regnault, in inches.	
	T°	T′	T°	T′
(1) February 12 .. 11.30 p.m.	52·3 F.	22·5 F.	0·3925	0·1206
(2) February 13 .. 11 p.m.	48·5	38	0·3414	0·2291
(3) February 15... 12.30 p.m.	48·7	44	0·3439	0·2882
(4) February 16 .. 1.30 a.m.	39	36	0·2382	0·2119

Case.	(d) Relative humidity in hundredths.	(e) Weight cubic foot air under given conditions (in grains).	(f) Wt. vapour present in cub. ft. air under given conditions (in grains).
		Corrected to mean barometric pressure of 29·3 English inches	
(1)	30·7	526·7803	1·3145
(2)	67·1	529·9801	2·4982
(3)	84·5	529·6004	3·1317
(4)	89	540·6601	2·3965

The figures in the last two columns are deduced from the Greenwich observations, while for those in columns (*c*) and (*d*) I am indebted to Regnault.

Unfortunately, I have not the height of the barometer at the time of my determinations, but have assumed a mean pressure, covering the four days on which they were made, equal to 29·3 inches of mercury, and have corrected the figures given in columns (*e*) and (*f*) in accordance with this assumption.

The figures given are open to further correction, while some are but approximations.

In case (3), if the relative humidity be calculated by multiplying the factor 100/F into the elastic force of vapour at the dew point the result, $0·2882 \times 100/F = 290·8 = 83·8$, is

slightly different; while the values for the elastic force of vapour have not been corrected for the assumed barometric pressure. Nevertheless, a decidedly rapid increase in the humidity of the atmosphere is shown, and in considering the table, it must be borne in mind that the results, if reduced to a mean temperature, would be even more striking.

Barnet, February 18. E. V. WINDSOR.

Lagrange's Equations.

As most of the standard treatises on dynamics contain satisfactory proofs of Lagrange's equations, I do not see that any useful purpose is served by proposing an additional one. The important point is this:—That amongst the numerous forms in which the kinetic energy of a dynamical system can be expressed, there is *only one form* which can be employed in using Lagrange's equations, and that is the *Lagrangian* form in which T is expressed as an n-ary quadric of velocities which are the time variations of the coordinates.

Similarly in using Hamilton's equations

$$\frac{d\Theta}{dt} + \frac{\partial}{\partial\theta}(\mathfrak{T} + V) = 0$$

$$\frac{\partial\mathfrak{T}}{\partial\Theta} = \dot{\theta},$$

there is only one form, viz. the *Hamiltonian* form, which it is permissible to use in which $\mathfrak{T}$ is expressed as an n-ary quadric of momenta of the same type as the coordinates of the system. Now the form $\frac{1}{2}(A\omega_1^2 + B\omega_2^2 + C\omega_3^2)$ is neither Lagrangian nor Hamiltonian, and therefore cannot be used in either equations.

A. B. BASSET.

Fledborough Hall, Holyport, Berks, March 6.

A Remarkable Meteor.

I SEND an account of a meteor, to me remarkable because of its extremely slow movement and also because of its apparently reaching the surface of the earth, a little east of north-east of here. The "falling star" was about equal in brightness to Sirius. When first it attracted my attention it would be just below the cluster "Coma Berenices." So slowly was it falling that I first mistook it for the fixed star Arcturus, the resemblance being probably increased by its colour, which was reddish. It slowly dropped vertically downwards, its brilliancy keeping constant; it left no trail. Its line of descent would make a small angle with the line $\delta\beta$ Leonis. I watched it fall right to ground—but it may not have quite reached earth, as there was a rise in the ground before me. About one-third of its distance from the ground it appeared to "wobble," but that may have been an illusion. It fell so slowly as to take quite five seconds. The time was about 7.22 p.m. on March 15, when I was a little more than a mile to the south of Basingstoke.

J. E. C. LIDDLE.

Fairfields, Basingstoke, Hants.

Dawn of Modern Geography.

IN the review of my book ("Dawn of Modern Geography," vol. ii.) which appeared in NATURE, November 27, 1902, it is stated (p. 75), by way of repetition from NATURE's review of vol. i. of the same work, that the "revision of the whole of chapter vi. of vol. i., on geographical theory, together with Mr. Beazley's account of the history and use of mediæval maps for the whole book," was "due to Mr. C. H. Coote, of the Map Department of the British Museum." When this unfounded assertion was first made, I wrote (with the entire concurrence of Mr. Coote) and pointed out to the reviewer that he was mistaken. As the misleading statement now reappears, I may say that Mr. Coote never saw a line of the "Dawn of Modern Geography," vol. i.—nor had I any consultation with him on any point therein—until after the last corrections of proof had been made, and the sheets finally returned for press.

C. RAYMOND BEAZLEY.

Nernst Lamps in Lanterns.

It was suggested to me by a friend to use a Nernst lamp in a lantern. On trying the experiment I have found that a one ampere 220 volts Nernst lamp gives quite a fair result in a small lantern, certainly very much better than could be got with oil wicks, and when put at a small angle from the horizontal the filament gives a very concentrated light. For lantern purposes it would be quite possible to remove the heating coil and to start the lamp by means of an alcohol flame. Indeed, I think that a special Nernst burner could be made for lanterns, giving a high candle power and fitted with a suitable fitting, which would largely replace limelight, and it would even in many cases replace the arc lamp where a powerful light was not required. There can be no doubt whatever about its convenience.

C. TURNBULL.

Electricity Works, North Shields, March 16.

PHOTOGRAPHS OF VOLCANIC PHENOMENA.[1]

THE application of photography to the recording and illustrating of volcanic phenomena has done much to secure accuracy, and the avoidance of those sources of error to which the students of these stupendous outbursts must always be particularly liable. Valuable as are the drawings made under the superintendence of Sir William Hamilton for his classic work, "Campi Phelgræi," they do not carry the conviction to the mind of a reader of the work that actual photographs would do; while many of the drawings of volcanic phenomena in less carefully illustrated works are faulty and exaggerated almost to grotesqueness.

Perhaps the first serious attempts to show the features of a volcanic outburst by means of instantaneous photography were those made by an enterprising photographer of Naples, during the Vesuvian eruption of 1872. He obtained three photographs at different hours, which illustrate very clearly the scale, the principal details and the changes of phase in the outburst. These photographs have since been reproduced in many geological treatises.

During the visit of the Geologists' Association to the South Italian volcanoes in 1890, a number of photographs were obtained by members of the party which demonstrated the value of instantaneous photography in recording all the successive stages of an outburst. Some of these photographs were reproduced in a memoir published by Dr. Johnston Lavis at Naples in 1891.

Dr. Tempest Anderson's contributions to the subject appear to have begun in 1885, when he read a paper, illustrated by admirable photographs, before the Geological Section of the British Association at Aberdeen. This paper dealt specially with the extinct volcanoes of Auvergne. In subsequent years, Dr. Tempest Anderson has visited almost all accessible volcanic districts—Italy and Sicily, the Canaries, Iceland, and various parts of the North American Continent. Last year he volunteered, at his own expense, to join the expedition sent out by the Royal Society to report on the eruptions of St. Vincent and Martinique, and the results obtained by Dr. Flett and himself have just been published in the *Transactions* of the Royal Society.

The work before us consists of reproductions by

[1] "Volcanic Studies in Many Lands: being Reproductions of Photographs by the Author of above One Hundred Actual Objects, with Explanatory Notices." By Tempest Anderson, M.D., B.Sc. Lond., F.G.S., F.R.G.S., A.C., Fellow of University College, London, Hon. Sec. Yorkshire Philosophical Society. Pp. xxviii + 202; plates i. to cv (London: John Murray, 1903.) Price 21s. net.

means of half-tint blocks, for the most part of a very clear and satisfactory character, of photographs taken by the author. Each plate is accompanied by a letterpress description, calling attention to the principal phenomena which are illustrated in the plate. In a short introduction upon "Photographic Methods," the author gives a number of valuable hints, which cannot fail to be of service to every geologist who wishes to go abroad armed with the camera. Dr. Tempest Anderson's remarks on the lenses to be employed, on the importance of the use of a firm stand, and on the relative advantage of plates and films, should be read by everyone desirous of doing good work in this direction.

Of the photographs reproduced in the 105 plates of this volume, seventeen are taken from Vesuvius and the surrounding country, two from Etna, eight from the Lipari Islands, eleven from the Auvergne and Central France, eight from the Canaries, thirty-two from Iceland, five from the Eifel and Central Germany, eight from the Yellowstone Park and other parts of the Western Territories of North America, ten from various ancient volcanic districts in the British Isles, and four from the West Indies.

FIG. 1.—A Gâj (pronoun Geow), Reykjanes Peninsula, Iceland.

Most of the pictures are wider than the page of NATURE, but the one here reproduced will give a good idea of their general character. Those who have seen reproductions as lantern-slides of these photographs thrown in an enlarged form upon a screen can testify to their excellence and value. The fact that in many cases—notably in Iceland and the West Indies—the work has had to be carried on under most unfavourable conditions, while it increases our admiration for the skill and perseverance of the author, cannot but greatly enhance the value of the results obtained. The author of this work is to be congratulated upon having discovered a field of work in which he is able to make such valuable contributions to science.

J. W. J.

THE AFTERMATH OF THE PARIS EXHIBITION.

THE size and importance of the Paris Exhibition of 1900 is beginning to be appreciated in its true significance. Many who visited the exhibition in a casual way were greatly impressed with its vastness and came away with the feeling that the exhibition was a marvellous illustration of the Frenchman's power of organisation; but that, owing to its very immensity, it lost much of its practical value. The aftermath of the exhibition is still with us, and we begin to see—from the number of special reports upon the different departments—that although not a financial success, the exhibition has left its mark upon commerce and science in a way that bids fair to rival, in its economic results, the immense advantages that accrued to this country from the Great Exhibition of 1851, and justly to warrant the enormous labour put forth in its inception and organisation.

In the *Revue générale des Sciences* (November, 1902) Prof. A. Haller, of the Paris University, contributes the first part of a most interesting and suggestive article upon the "Chemical and Pharmaceutical Industries" at the Paris Exhibition. He commences with a reference to the retrospective stand, where apparatus and substances of historical interest were exhibited. Amongst these exhibits were specimens of aluminium as prepared by Wöhler, sulphuric anhydride by Winckler, the first specimen of magnesium which was prepared electrolytically by Bunsen, and many other products and apparatus of historical interest. He then goes on to refer to artificial substances such as ultramarine, synthetical perfumes, pharmaceutical preparations and a very complete collection of coal-tar dyes.

The article is mainly devoted to the German chemical industries, and by far the most interesting paragraphs are those in which Prof. Haller reviews the great advance in German science, and endeavours to assign a reason for this phenomenal development. *En passant*, he regrets that Great Britain did not see her way to send apparatus and specimens of historical interest, which she, who can boast of the great names of Priestley, Cavendish, Davy and Faraday, might so easily have done.

The recent trade depression in Germany has attracted considerable attention, but although many branches of industry have been passing through a period of great difficulty, and the total German exports for 1901 showed a decrease of 240 million marks, the exports of the chemical trade showed *an increase* of 10 million marks. Prof. Haller attributes much of the success of the Germans in the chemical trade to the management and to the employment of men of high scientific

training and attainments. He illustrates his point by giving an outline of the organisation of a typical chemical works in Germany. The management consists of a business man, a chemist and an engineer, and attached to each department is a special research laboratory. Both the laboratories and workshops are splendidly fitted with every appliance necessary for carrying out the most complicated and exact operations. The expenditure upon chemicals, books and apparatus would appear to a British manufacturing company to be absolute lunacy, the Badische Anilin und Soda Fabrik alone spending more than 5000*l*. a year on glass and porcelain apparatus. The consulting library attached to the laboratories of F. Baeyer and Co., of Elberfeld, contains no less than fourteen thousand volumes and twenty-three thousand pamphlets of an original character.

As to the methods of research, when a new compound has been discovered which is found to have, say, dyeing properties, it is sent to the dyeing department, where a chemist, who has made a speciality of that particular branch of chemistry, subjects it to the most exhaustive tests, and tries its behaviour on cotton, wool, silk, paper, leather, &c. Should any of these tests turn out in a satisfactory manner, the substance is then subjected to tests on a semi-manufacturing scale. Again, a new preparation which may be expected to possess therapeutic properties is sent to the medical department, where its physiological effects are tried. These articles having successfully passed through the experimental stages, the business man is called in, and they are placed on the market. Circulars and pamphlets are sent out, which set forth the effects and uses of the articles. These circulars are printed in *all* the European languages, and often in those of Asia. Samples are sent out, and travellers, who are accomplished chemists, visit works and business houses where the articles may be used. These men place their knowledge and skill at the service of the consumer, while they demonstrate how the articles may be used to the greatest advantage. In no case do they endeavour to plant their products upon their customers against their will, and, if necessary, the articles are so far as possible modified to meet their customers' tastes and prejudices. Little or nothing is left to chance; everything that ingenuity and business experience can suggest is resorted to in order to obtain the market.[1]

Prof. Haller recognises that the patent laws of 1878 have been of great benefit to the German manufacturers. But patent laws are only useful when there are inventions to be patented and processes to be protected. He further recognises that the mineral wealth of Germany has been of incalculable value to the nation, because it has, to a large extent, rendered it independent of outside nations for its raw products. For example, the wonderful deposits of Stassfurt enable the Germans not only to supply themselves, but the world at large, with potassium salts.

Prof. Haller considers the scientific training obtainable at the universities and polytechnics to be the main reason of the astonishing development of the German chemical industry. It must not be forgotten that beside the universities and polytechnics, there are special academies where the general outlines of chemistry are taught, and where special applications of science to industry are studied. For example, the Mulhausen School of Dyeing and Printing, the Electrochemical Institute at Darmstadt, the Mining Academy at Freiberg. Then there are purely technical schools, where such subjects as sugar making, brewing, pottery, &c., are taught.

The Germans believe in an aristocracy of brains, and owing to this and the high social standing which follows educational success, many are attracted to the universities, not simply to obtain university polish, but to devote their energies to hard study and scientific research. The British man of science is inclined to look upon the commercial applications of science as beneath him. But is there not a tendency for the German man of science to go to the other extreme, and look upon science as simply an aid to commercial success? We do not want to commercialise science, but we do desire to make commercial methods more scientific.

We await with interest Prof. Haller's further article upon the chemical industry of England, Russia and the United States. F. MOLLWO PERKIN.

[1] "The British merchant sells the goods which he deals in and has selected himself, and leaves it to the customer to adapt himself to the merchandise. The German individualises and meets the wants of his customers; he adapts his merchandise, credit, conditions of sales, decoration, packing, &c., to the wants and desires of his client Thus he often gains a start, for the buyer is but seldom in a position to value quality and prices. Another point is forced on the observer, and this is the great start in scientific training which Germany can boast of." (Diplomatic and Consular Reports, No. 2484.)

REMARKABLE WINTERS.

THE period of winter for purposes of the present article may be defined as embracing the six months October to March, although when dividing the year into four seasons, the winter then for meteorological purposes is comprised in the months of December, January and February. Generally speaking, temperature is the most important factor in deciding whether a winter is severe or otherwise, although there are other aspects which render the weather disagreeable. When gales occur with more than ordinary frequence the winter is characterised as stormy, and similarly when rains are heavy and of common occurrence the winter is characterised as wet. Our winters in England vary to so great an extent in their general character that it is not always easy to say with scientific precision whether a winter may or may not be styled as remarkable. It generally happens that when a winter is cold the weather is fairly dry and there are fewer gales than usual, although, on the other hand, the quiet conditions are favourable to fog formation. In a mild winter the weather is usually wet, and storms are of common occurrence, the mild weather being very intimately associated with the arrival of cyclonic disturbances from the Atlantic, and as the common track of these storms takes the centres of the disturbances over the northern portion of our area we, in England, for the most part experience the south-westerly and westerly winds which bring us the moist and warm air from off the ocean to the westward of us. For the purposes of comparison the data used refer almost wholly to Greenwich, where the long series of observations made at our national observatory is eminently suitable, and, so far as the weather of a winter is concerned, there is probably no real disadvantage in restricting the area of comparison to one locality, since in a general sense it would be equally applicable to most other parts of England. The coldest winters of recent years are those of 1890-1 and 1894-5, in which there were respectively ten and eleven days with the temperature below 20° F. at Greenwich. In the last sixty years there have only been two other winters with so low a temperature on ten days; these were 1854-5 with twelve such cold days, and 1880-1 with ten days. The greatest number of days with frost during the period of sixty years was eighty in the winter six months of 1887-8, and the winters with seventy or more days of frost were 1844-5, 1846-7, 1854-5, 1874-5, 1878-9, 1879-80, 1885-6, 1886-7, 1887-8 and 1890-1. Using this as a test for the mildness of the winter, the least number

of frosty days was nineteen in the winter of 1883-4, and there were fewer than thirty-five days with frost in the winters of 1845-6, 1850-1, 1858-9, 1862-3, 1865-6; 1876-7, 1881-2, 1883-4, 1895-6 and 1897-8. In the five out of the six months already elapsed of the present winter there have been twenty-one days with frost, and as yet the screened thermometer has not fallen below 23°·6. The winter (six months) with the lowest mean temperature at Greenwich is 1844-5, when the mean was 38°·8, and the winters with the mean below 40° were 1844-5, 1854-5, 1878-9, 1885-6, 1887-8 and 1890-1. The winter with the highest mean temperature was 1898-9, when the mean for the six months was 45°·4, and the mean for each of the six months, with the exception of March, was above the average. The winters with the mean temperature above 44° were 1845-6, 1847-8, 1848-9, 1862-3, 1876-7, 1883-4, 1897-8 and 1898-9. The mean for the five out of the six winter months already elapsed (1902-3) is 44°·6, so that it is most highly probable that the present winter will rank as one of the foremost for its general mildness.

Limiting the winter to a period of three months—December, January and February—the coldest winter in the last sixty years at Greenwich is 1890-1, with a mean temperature of 34°·3, or 5° below the average, and during this period the mean temperature for December was 29°·9, January 33°·9 and February 39°·1. The second coldest winter was 1846-7, with a mean of 34°·5, or 4°·8 below the average. In 1894-5 the mean temperature for the winter was 35°·1, or 4°·2 below the average, and February, 1895, with a mean temperature of 29°·3, was the coldest of any winter month since 1841, with the exception of 29°·2 in February, 1855, and during this month (February, 1895) frost occurred in the screen on twenty-three nights, the lowest shade temperature being 6°·9, and for six consecutive days the thermometer did not once rise above the freezing point. The warmest winter (three months) was 1868-9, with a mean of 44°·4, or 5°·1 above the average. The second warmest winter was 1876-7, with a mean of 43°·7, which is 4°·4 above the average. The winters (December to February) with the mean 3° or more below the average are 1844-5, 1846-7, 1854-5, 1864-5, 1878-9, 1879-80, 1885-6, 1890-1, 1894-5. The winters with the mean 3° or more above the average are 1845-6, 1848-9, 1862-3, 1865-6, 1868-9, 1876-7, 1898-9, and the present winter, 1902-3, when the mean temperature was 3°·1 above the average. The mean temperature of February, 1903, was 45°·3, which is the warmest since 1869, and it was 16° warmer than 1855 and 1895. February had been cold for the previous three years, and it seemed probable that it would have been so this year, but experience has proved otherwise. At the commencement of the present winter, it was pretty confidently believed by many meteorologists that the winter would be severe, but such a belief has proved a most complete failure. It is, however, hoped that in the somewhat near future long period weather forecasts may be attempted. At present the forecaster is bound to admit his utter inability to form anything like an accurate estimate of our coming weather in England for more than twenty-four hours in advance, except when we are experiencing pronounced cyclonic or anticyclonic conditions, when we may with fair safety venture an opinion for, say, a week. The absolutely lowest winter temperatures at Greenwich (below 10°) are 4°·0 January 9, 1841; 7°·7 February 12, 1845; 8°·0 December 25, 1860; 6°·6 January 5, 1867; 9°·8 December 25, 1870; and 6°·9 February 8, 1895. The absolutely highest temperatures in each of the three winter months are December, 1848, 62°·4; January, 1843, 57°·0; February, 1846, 62°·3; 1868, 61°·7; 1869, 61°·6; 1878, 60°·5; 1891, 62°·1; 1899, 63°·9. The winter of 1885-6 was severe and very prolonged, and it is apparently the only winter with skating on the waters around London in each of the four months December to March.

The average rainfall at Greenwich for the winter six months for the last sixty years is 11·82 inches, and the winters with the aggregate rainfall in excess of 14 inches are 1852-3, 1865-6, 1868-9, 1872-3, 1876-7, 1880-1, 1882-3, 1896-7, 1899-1900. The wettest winter of the whole series was 1876-7, with an aggregate rainfall of 18·72 inches. The driest winters, with a rainfall below 8 inches, were 1858-9, 1873-4, 1879-80, 1890-1 and 1897-8. The driest winter was 1879-80, with a total rainfall of 5·54 inches. The aggregate rainfall for five out of the six winter months of the winter 1902-3 is 7·3 inches, which is 4·5 inches less than the average for the six months during the last sixty years, and it is exceedingly improbable that the whole winter (October to March) will prove to be wet. Only two years have been wet at Greenwich out of the last fourteen years, but seven of the last fourteen winters have been wet, and ten of the last fourteen Decembers have been wet. The tail end of the present winter is proving very stormy, and for their destructive character the recent gales, as shown by the publications of the Meteorological Office, seem likely to prove as generally disastrous as any experienced for a long time past.

Chas. Harding.

A UNIQUE VARIABLE STAR.

Messrs. Müller and Kempf, of the Astrophysical Observatory of Potsdam, have recently announced the discovery of a variable star of so short a period that it must take a unique position among this class of phenomena. Up to this time the variables which went through a complete cycle of their light phases in the shortest time were those two stars situated in the rich star cluster ω Centauri; these bodies completed their periods in 7h. 11·4m. and 7h. 42·8m. Another variable running these rather close is that of S. Antliæ, the period of which is 7h. 46·8m. The new variable is, however, of a much shorter period than any of these, nearly one-half as short, occupying only four hours and a few seconds to complete its light changes.

The discoverers of this variable had their attention first brought to this object in their work on the photometric survey, in which it was noticed that there was a great difference between two measures of this star (B.D. + 56°1400, R.A. = 9h. 36m. 44s., Decl. + 56° 24′·6, 1900) that exceeded the usual error of observation. A closer examination of the star itself was then undertaken, and a series of observations extending over the year 1902, and part of this year, was made. The account of this research, recently published (*Sitz. Ber. der K. Preuss. Ak. der Wiss.*, February 5, 1903, vii.), gives the details of the observations and the conclusions arrived at.

The diagram accompanying the paper shows that the light-changes at an epoch of minimum vary very quickly, the curve being quite pointed at these times. From minimum to maximum the light changes at rather a slower rate than from maximum to minimum, and at about maximum the star apparently changes its magnitude very little, so that the exact epoch of the maximum is not so easy to determine as that of the minimum. During these changes the magnitude varies from 8·58 to 7·9, and the length of the period, as at present determined, is 4h. 0m. 12·8s., with an error, as stated, of probably about 0·5s. For computing the times of minima the following equation is given :—

Min. = 1903 January 14, 4h. 32m. (Greenwich mean time) + 4h. 0m. 12·8s. E.

The discoverers suggest that the hypothesis of stellar variability, which best seems to explain this light curve, is that which involves two bright bodies revolving at a small distance round their centre of gravity, the plane of revolution being nearly in the line of sight. It will be interesting, therefore, to examine this variable spectroscopically and see whether the spectrum changes and if so in what manner.

WILLIAM J. S. LOCKYER.

NOTES.

THE French Congress of Scientific Societies will hold its forty-first annual meeting at Bordeaux on April 14–18.

THE deaths are announced of Prof. C. Dufour, professor of astronomy at the University of Lausanne, and of Prof. René Mamert, professor of chemistry at the University of Freiberg.

IT is announced in *Science* that Prof. George B. Shattuck, professor of physiographic geology of the Johns Hopkins University, has been authorised to organise an expedition for a systematic scientific survey of the Bahama Islands.

THE executive committee of the Carnegie Institution has approved a grant of 300*l.* to Mr. G. R. Wieland, of the Yale University Museum, for the continuation during the year 1903 of his researches on the structure of the living and fossil cycads.

PROF. J. B. TINGLE, professor of chemistry at Illinois College, Jacksonville, Ill., has received a grant of 100*l.* from the Carnegie Institution to enable him to continue his investigations of derivatives of camphor and allied compounds.

THE Academy of Sciences at Berlin has made grants of 200*l.* to Prof. Landolt and of 150*l.* to Dr. Marckwald, both of Berlin, for work in chemistry; of 100*l.* to Dr. Danneberg, of Aachen, for work in mineralogy; and of 80*l.* to Prof. Kobert, of Rostock, for work in pharmacology.

THE council of the Iron and Steel Institute has resolved to award the Bessemer gold medal for this year to Sir James Kitson, M.P., past-president, in recognition of his great services to the iron and steel industry of Great Britain. The presentation of the medal will be made by Mr. Andrew Carnegie at the annual meeting on May 7.

THE Paris Natural History Museum has received a gift of an important collection of Lepidoptera, containing about twenty thousand specimens, from M. E. Boullet. The donor desires that his collection be incorporated with the specimens already possessed by the Museum, so that in this way a series worthy of the Paris museum may be formed.

THE Lucy Wharton Drexel medal of the University of Pennsylvania has been presented to Prof. F. W. Putnam. The medal was established four years ago, but no awards were made until this year, when four were awarded at one time, the other recipients being Prof. Petrie, for his work at Abydos; Dr. Evans, for his excavations at Crete; and Prof. Hilprecht, for work in Babylonia.

WE learn from *Science* that the Bill creating a department of commerce in the United States, with a secretary in the Cabinet, has passed the House and Senate. The new department will include, with other departments, the Lighthouse Board, the Lighthouse Establishment, the Bureau of Navigation, the Bureau of Standards, the Coast and Geodetic Survey and the Bureau of Foreign Commerce (now in the Department of State).

IT was reported last week that Vesuvius was in eruption. The following messages have since been received:—Wednesday, March 11.—Eruption increased in intensity. Huge columns of vapour emitted from the crater with blocks of incandescent lava. Friday, March 13.—Eruption continues, but with decreased intensity. Two rents have opened in the central crater, and from these molten lava and pumice are ejected at half-minute intervals. The bombs are sometimes thrown to a height of 1000 feet.

A DIVISION OF HYDROLOGY has recently been added to the Hydrographic Branch of the United States Geological Survey. The work of the division will include the gathering and filing of well records of all kinds, the study of artesian and other problems relating to underground waters, and the investigation of the stratigraphy of the water-bearing and associated rocks. In addition to the gathering of statistics relating to the flow, cost, &c., of the wells, it is hoped in the future to give especial attention to the geological features which govern, or which are related in any way to, the supply of water.

M. BIALYNITSKY-BIROULIN, the zoologist of Baron Toll's Arctic expedition, has stated to the Irkutsk branch of the Russian Imperial Geographical Society that Baron Toll left the yacht *Sarja* on June 9 on the islands of the north coast and proceeded to Cape Wyssoki, where he arrived on July 10. Here he deposited a statement to the effect that all was well with him and his followers, and that the dogs were in good condition. Baron Toll started for Bennett Land on July 13 with three sleighs and forty-five dogs. If a passage through the ice to the *Sarja* should not be open, M. Biroulin says that Baron Toll intended wintering in Bennett Land.

THE fourth annual general meeting of the National Association for the Prevention of Consumption and other forms of tuberculosis was held on Tuesday. Lord Derby occupied the chair, and in moving the adoption of the report, he referred to the interest which was taken by foreign countries through communication with the association in connection with the International Bureau. The report showed that the death rate from tuberculosis in Prussia had decreased since 1886, and, although a decrease had occurred in England, and the death rate was still lower than that of Germany, the decrease had not been so great as that in Prussia. The council expressed the opinion that the greater drop in the death rate from tuberculosis in Prussia was due to the widespread knowledge of tuberculosis, the preventive measures taken in that country, and the large number of sanatoria established during recent years. In Germany the individual was taken care of, and was watched by the State through all periods of the existence of the disease.

A REUTER telegram from Vienna states that Prof. Hanos Molisch, of Prague, "has reported to the Vienna Academy of Sciences the discovery of a lamp lighted by means of bacteria." It will be remembered that, at the Royal Society conversazione in May, 1901, Mr. J. E. Barnard and Dr. Allan Macfadyen exhibited several striking experiments with luminous bacteria from the bacteriological laboratory of the Jenner Institute of Preventive Medicine. A year ago (April 10, 1902) Mr. Barnard contributed an account of luminous bacteria to these columns, and his remarks were illustrated by reproductions of cultures of these organisms. Prof. Molisch's lamp would seem to offer another instance of the industrial application of the results of research in pure science. According to the Reuter message, "the lamp consists of a glass vessel, in which a lining of saltpetre and gelatine inoculated with bacteria is placed. Two days

after inoculation the vessel becomes illuminated with a wonderful bluish-green light, caused by the innumerable bacteria which have developed in the time. The light will burn brilliantly for from two to three weeks afterwards, diminishing in brightness."

The following annual awards have been decided by the council of the Royal Geographical Society, and the King, as patron, has approved of the award of the two Royal medals. The founder's medal to Mr. Douglas W. Freshfield, for his explorations in the Caucasus and the Himalaya, and for his persistent efforts to extend the scope and raise the standard of geographical education.—The other Royal medal to Captain Otto Sverdrup, the leader of the *Fram* expedition, extending over a period of four years, which has done much to complete our knowledge of the geography of the Arctic regions. Captain Sverdrup was captain of the *Fram* during Dr. Nansen's great expedition, and assumed command when Nansen left the ship.—The Victoria medal for geographical research to Dr. Sven Hedin.—The Murchison grant to Mr. Isaachsen, a lieutenant in the Norwegian army, who accompanied Captain Sverdrup on his last expedition.—The Gill memorial to Mr. Ellsworth Huntington, an American traveller, for his journey through the Great Cañon of the Euphrates River, during which he made valuable observations in physical geography.—The Back grant to Dr. W. G. Smith, of Yorkshire College, Leeds, for his investigations into the geographical distribution of vegetation in Yorkshire, embodied in maps and a paper which will shortly be published.—The Peek grant to Major Burdon, who has compiled a number of excellent route maps as the result of his journeys in Northern Nigeria.

We have received a paper on "A Scale of Interference Colours," by M. Camille Craft, reprinted from the *Bulletin de l'Académie des Sciences de Cracovie*. The object of the author was to examine the interference colours produced by thin films, and to observe the positions and breadths of the black bands in the spectra of these colours. A Biot's compensator was employed, composed of three quartz plates cut parallel to the axis, two plates being slightly wedge-shaped so that the thickness could be adjusted within considerable limits. The plates were immersed in essence of anise, which has a refractive index nearly equal to that of quartz, and the light traversing the compensator was polarised and analysed by means of Nicols. Spectra of the colours were formed by the aid of a Rowland grating. Tables and curves are given for five different sources of white light. Further, the correspondence of the interference colours produced in the above manner with those due to a thin air film are also tabulated.

The first part of the report of the expedition, consisting of Dr. Tempest Anderson and Dr. J. S. Flett, that was sent out last year by the Royal Society to investigate the eruptions of the Soufrière in St. Vincent has just been published as a separate paper from the *Philosophical Transactions*. The report occupies two hundred pages, and is illustrated by eighteen fine plates representing the characteristics and effects of the eruptions. The preliminary report of the expedition was summarised in Nature of August 21, 1902 (vol. lxvi. p. 402).

The dust fall recently recorded in many parts of the south of England and Wales seems to have been more extensive than was at first supposed. Information is now coming to hand to show that some parts of the Continent were also visited. In Austria (*Meteorologische Zeitschrift*, Heft ii., February, 1903) the dust fall seems to have been on quite a large scale, judging by the accounts given in the above-mentioned journal. At Kremsmünster, for instance, dust fell both on February 22 and 23, with the wind in the west, and there was a haze described as smoke-like. In Lower Austria, at Loosdorf, on the afternoon of February 23, all the trees were covered with a yellow dust. Similar phenomena were recorded at Pyhrn (Upper Austria), at Graz and other places.

We have received in the form of a supplement to "Wragge," January 22, 1903, a letter addressed to the people of the Australian Commonwealth by Mr. C. L. Wragge. It deals with the circumstances under which the grant for the maintenance of the observatory, established in December, 1897, through Mr. Wragge's exertions, upon the summit of Mount Kosciusko, was withdrawn. It protests against the treatment which the enterprise has received from various Government authorities, and appeals to the Australian people to take over the pecuniary obligations in connection with the maintenance and dismantling of the observatory, which have apparently been surcharged upon the director.

The summary of the weekly weather report (appendix i.), issued by the Meteorological Council, giving the rainfall values for the whole year 1902, and the means for thirty-seven years, 1866 to 1902, shows very clearly the differences from the average in the eleven districts into which the British Islands are divided for the purposes of weather forecasts. It is seen that in only two districts, the north and west of Scotland, the rainfall exceeded the average (in the latter case to the extent of nearly seven inches). In the north-west of England the deficit was nearly nine inches, and in the south-west of England nearly eight inches; in all other districts the deficit varied from two to four inches. In the principal wheat-producing and grazing districts, and for the whole of the British Islands, the general means for the year 1902 were about three inches below the average.

Father Baur, director of the Ignatius College Observatory at Valkenburg, Holland, and Father Cortie, of Stonyhurst College, have written to us with reference to the English version of Dr. Paul Bergholz's "Orkane des fernen Ostens," revised by Dr. R. H. Scott and reviewed in Nature of May 15, 1902 (vol. lxvi. p. 51). They point out that Dr. Bergholz's work is itself an abridged translation of one by Father José Algué, director of the Manila Observatory, entitled "Baguios ó Ciclones Filipinos," which appeared in 1897. Dr. Bergholz acknowledges his indebtedness to Father Algué in his preface, but the relationship between the German and the Spanish books is not clearly stated, and neither our reviewer of the English edition nor meteorologists generally were aware of it. The following letter, which Dr. Scott has kindly sent us, shows that Father Algué must be given the credit for the original work:—

"With reference to the work by Dr. Bergholz, I can only say that when, in March, 1900, I commenced the revision of the English version of the book, 'Hurricanes of the Far East,' to correct the German idioms in the sheets sent to me, I had not seen the work by Padre Algué, 'Baguios ó Ciclones Filipinos,' for no copy of it had reached the Meteorological Office at that date. I noticed frequent reference to the Spanish work in Dr. Bergholz's proofs, and supposed that an understanding existed between him and Padre Algué, which it appears is not the case. Dr. Bergholz, in his preface, acknowledges that he has used Padre Algué's work freely."

Prof. G. Hellmann, of the Prussian Meteorological Institute, has recently published another rain-chart in addition to those that have already appeared. In the present instance

the region surveyed in this way is the province of Westphalia, including Waldeck, Schaumburg-Lippe, Lippe-Detmold and the neighbourhood of Rinteln. The chart, which is published by Messrs. Dietrich Reimer in Berlin, contains, besides tables, an explanatory text describing much useful information concerning the monthly and yearly rainfalls of the various districts. The mean values employed are those that have been determined from a reduction of observations extending over the ten years 1892-1901, and 201 stations have been included in the discussion. Although the period of ten years is rather short for some purposes of deduction, when it is considered that there is a secular variation of rainfall of about thirty-five years, yet Prof. Hellmann gives some interesting figures in respect to the variation of rainfall in this decade. Thus he says that for all practical purposes it can be assumed that in the province of Westphalia the yearly fall varies between 134 and 66 per cent. of the mean value, or that during the wettest year twice as much rain fell as in the driest year. From the statistics of two stations, as Gütersloh and Arnsberg, extending from 1836 and 1866 respectively, the wettest years were 1841, 1843, 1867, 1880, 1882 for the former, and 1867, 1880, 1882, 1895, 1898 for the latter. The driest years for the two places were 1847, 1857, 1865, 1874, 1885, and 1874, 1887, 1892 respectively.

Two simple lecture experiments described by Dr. Garbasso, of Turin, in the *Nuovo Cimento* are worthy of notice. One consists in arranging three Bunsen coils, of E.M.F. 1·8 volts and internal resistance 0·1 ohms, successively in series and in parallel, first with a wire of resistance 0·009 ohms, and secondly with a lamp of resistance 10 ohms. A calculation of the currents produced in the four cases is confirmed by the experimental result that the wire glows when the cells are in parallel but not when they are in series, while the lamp glows when they are in series but not when they are in parallel. The second experiment consists in showing the dynamical action between unlike parallel elements of the same current by means of a so-called "plane spiral," which consists of a wire bent so as to form branches alternately to the right and left, separated by vertical portions. When a current is passed through the wire the "spiral" becomes elongated, and that this effect is not due to heating is shown by breaking the current; if the latter has been of short duration, the spiral will resume its previous length. The spirals of Roget utilised by Róiti in his interrupter show the attractive force between elements of like parallel currents; in the present case the current elements are unlike, and they repel each other.

CONSIDERABLE uncertainty has in the past prevailed regarding the limits of combustibility of different flames as measured by the percentage of carbon dioxide and other combustion products at the instant when extinction occurs. Different writers have given numbers varying from 1·7 per cent. of carbon dioxide for a small petroleum lamp up to 14 or even 25 per cent. for a candle. A series of experiments described by MM. L. Pelet and P. Jomini in the *Moniteur scientifique* tends to throw light on the question. The combustible was in every case burnt in a bell glass, and the gases remaining analysed after extinction. The general conclusion is that the limit of combustibility is not always the same for the same substance. It depends (*a*) on the nature of the substance, (*b*) on the temperature of the flame, (*c*) on the quantity of combustible gas introduced into the flame per unit of time, and (*d*) on the temperature of the surrounding air. The first three factors, however, are dependent to a large extent on each other, especially for liquid and solid combustibles, and it results that the chemical equilibrium between the combustibles, the oxygen and the products of combustion is a function of the temperatures alone. A practical application of the results to bath-heaters is considered.

AN article on the "Common Basis of the Theories of Microscopic Vision," contributed to the *Zeitschrift für wissenschaftliche Microscopie* by Mr. Julius Rheinberg, has been translated by the author and published in pamphlet form. The method of formation of an image by a microscope objective is considered in detail, from the point of view of the wave theory of light. By the use of carefully drawn diagrams, mathematical analysis is entirely dispensed with, while yet clear quantitative results are obtained. The general effect of a lens in altering the curvature of light waves passing through it is now generally known, but the conditions determining the resolving power of a lens might be popularised with advantage, and the pamphlet before us is well adapted to this end. Even those possessing the knowledge requisite to pursue the mathematical investigation of the subject will find it interesting and profitable to follow the author in his lucid and painstaking effort to obtain an explanation directly from first principles. Several reproductions of photographs are given, and these render the argument more effective. Those unacquainted with the wave theory will be surprised to find that, on looking through a microscope at a number of lines ruled on glass, it is possible, under suitable conditions, to see more lines than are actually in existence; so far from being true is the old adage that "seeing is believing."

WE have received two parts of the *Nat. Hist. Trans.* of Northumberland, Durham and Newcastle. In the one (vol. xii. part ii.) Mr. J. E. Robson completes the first volume of his catalogue of the Lepidoptera of the district. The second (xiv. part i.) includes a report on dredging and other marine researches undertaken by the Society in 1901. It is suggested that some of the flagellate infusorians met with in parts of the North Sea where there is no plankton may subsist on dissolved salts, like algas, and thus form the means whereby inorganic are converted into organic substances. This account is supplemented by the report on the scientific investigations carried out during 1902 under the direction of the Northumberland Sea Fisheries Committee. As regards fishing, the committee has to record an unusually successful season, and it gives an elaborate return of the number of marketable fishes captured. The report includes an account of the structural changes which take place in the common crab during the shedding of its shell, and likewise a description of its normal growth.

PROF. GRENVILLE COLE has contributed to a work entitled "Ireland: Industrial and Agricultural" an interesting sketch of the topography and geology of the country, and an account of Irish minerals and building stones.

IN a report upon the present condition of Rhodesia, presented to the Directors of the British South Africa Company (1903), Mr. J. F. Jones, C.M.G., expresses a sanguine opinion about the future of the country. There appears to be plenty of good coal, the auriferous deposits are of a "highly payable nature," while the "copper, zinc and lead deposits promise to rank among the richest in the world."

DR. A. VON KRAFFT describes the "Exotic Blocks" of Malla Johar in the Bhot Mahals of Kumaon (*Mem.* Geol. Surv. India, vol. xxxii. part iii., 1902). These blocks he attributes to volcanic outbursts, they being fragments torn from rocks *in situ*, through which the volcanic material

was forced. Many of the blocks exceed ten feet in diameter, while the smaller blocks are innumerable. Most of them are limestones, and some are sandstones, and they belong chiefly to Permo-Carboniferous, Trias, Lias and Flysch.

IN the *Proceedings* of the Nova Scotian Institute of Science (vol. x. part iii., 1902) Mr. W. H. Prest, who contributes an article on drift ice, states his conclusion that the Grand Banks of Newfoundland are almost solely the products of the period of maximum ice-erosion; they are principally due to prolonged wave action on true glacial moraines, and receive very little débris from the modern polar ice. Dr. H. M. Ami describes some tracks on a slab of Devonian sandstone, evidently made by a fin or spine-like appendage, possibly of a fish. There are sundry other papers dealing with local geology and natural history.

MR. T. H. HOLLAND contributes an interesting and important article on "The Mica Deposits of India" to the *Memoirs* of the Geological Survey (vol. xxxiv. part ii., Calcutta, 1902). He discusses the mineralogical and chemical characters, the geological occurrence and distribution, the uses of mica, and the mining practice. Crystals or "books" of muscovite-mica have been obtained in Nellore district, measuring ten feet across the basal planes, but usually they are much smaller. This mica occurs in granite-pegmatite, and being the most delicate mineral in the rock, it is the first to show the effects of crushing earth-movements, so that large quantities of valuable mineral have been destroyed; but the author observes it is on account of the remarkable stability of the Indian Peninsula, the geologically long and perfect quiescence it has enjoyed, that India is able to boast of the finest mica deposits in the world.

WE have received the annual report for 1901 of the Iowa Geological Survey, with accompanying papers. Mr. Samuel Calvin, the State Geologist, refers to the fact that the succession of events during the Glacial epoch is more clearly recorded in Iowa than elsewhere in America. Five Glacial and four inter-Glacial stages are recognised. He refers also to the subject of petroleum and natural gas, which occupy a large share of public attention; and remarks that it was not until the Trenton period of the Ordovician that life existed in such profusion as to furnish organic matter in sufficient amount to give rise to considerable quantities of gas or oil. Of succeeding formations those of Carboniferous, Cretaceous and Tertiary age are the most prolific in oil and gas. Statistics of the mineral production of Iowa for 1901 are contributed by Mr. S. W. Beyer. The geology of Webster county is dealt with by Mr. F. A. Wilder, who gives a particular account of the gypsum industry in Iowa, and a chapter on that of Germany. In Iowa, gypsum available for economic purposes is said to occur over at least forty square miles, and the average thickness of the mineral suitable for plaster is ten feet. Mr. T. E. Savage, who describes Webster county, gives particulars of the Carboniferous Limestone fauna, a subject also dealt with by Mr. J. A. Udden in reference to Jefferson county, and by Mr. A. G. Leonard in describing Wapello county. In Cherokee and Buena Vista counties the Pleistocene deposits and those of recent age occupy the entire region, and they are described by Mr. T. H. Macbride. The volume is well illustrated with maps, diagrams and pictorial views.

THE Indian *Monthly Weather Review* for July of last year gives an interesting account of some severe earthquake shocks which were experienced at Bunder Abbas, in the Persian Gulf, on July 9, 13, 18 and 20, of which the following is an abstract. The first shock, which was felt on July 9, was preceded by a strange rumbling noise, like thunder or the roar of big guns away out at sea, proceeding from the direction of the island of Kishm. The people in Bunder Abbas, astonished and alarmed, rushed from their houses and looked towards the island from which the noise seemed to come. Suddenly the first shock was felt, and this brought down a house in the vicinity of the bazaar with a crash, nearly killing a passer-by. The shocks were almost continuous, and kept the buildings in motion for nearly two minutes; they brought down some big boulders from the Portuguese fort, in which the governor resides, and these in turn unroofed the adjoining Customs Office. The tall buildings and wind towers either collapsed or remained in dangerous conditions. At Socr suburb, distant two and a half miles, the ground opened and water poured in. Most of the buildings were destroyed and several lives lost. Information from Kishm recorded the total destruction of most of the houses, but no loss of life. In Ormuz part of an old fortress collapsed, and slight shocks were felt at Minan, forty miles away. The earthquake was felt also on the hills behind the town of Bunder Abbas, and a cloud of dust obscured everything. On July 13, 18 and 20 more shocks were felt, all of which brought down numerous buildings, and after that the shocks continued almost daily. It is stated that there was not a building in Bunder Abbas which had not suffered. The bazaars and shops were closed and provisions difficult to obtain. Houses were abandoned, and everybody encamped in huts on the Maidan behind the town, at Naiband, or on the coast.

THE thirty-third annual report shows that the Wellington College Natural Science Society continues to flourish. The meteorological report for 1902 is a useful and instructive record, and the abstracts of lectures delivered before the Society show that interest is taken in the progress of knowledge.

THE sixteenth annual issue of the "School Calendar" has been published by Messrs. Whittaker and Co. at 1s. net. It contains complete and up-to-date particulars of available scholarships at the universities and colleges of Great Britain, in addition to other information likely to be of assistance to persons engaged in educational work.

THE Home Office has issued a set of tables relating to the output of coal and other minerals, and the number of persons employed during the year 1902 at mines under the Coal and Metalliferous Mines Regulation Acts. It is noteworthy that the output of coal, which was 219,037,240 tons in 1901, was 227,178,140 tons in 1902, showing an increase of 8,140,900 tons.

THE sixty-third volume, being that for 1902, of the *Journal* of the Royal Agricultural Society of England, has now been published by Mr. John Murray. Among the special articles of interest are those by Mr. Cecil Warburton, on orchard and bush-fruit pests and how to combat them; and by Dr. N. H. J. Miller, on the experiments at Rothamsted on the changes in the composition of mangels during storage. The official reports, which form the second part of the volume, include one by Dr. J. A. Voelcker, describing the field, the feeding and the pot-culture experiments at the Woburn experimental station of the Royal Agricultural Society. The third part of the volume contains, with much other important information, a summary by the editor of the recent evidence as to the identity of human and bovine tuberculosis, and reviews by Mr. W. Carruthers, F.R.S., of new works on agricultural botany, and by Dr. H. B. Woodward, F.R.S., of a work on agricultural geology.

THE additions to the Zoological Society's Gardens during the past week include two Magellanic Foxes (*Canis magellanicus*) from South America, presented by Baron Adolp Ott; a European Pond Tortoise (*Emys orbicularis*), European, presented by Mr. E. A. Hambro; two Smooth-headed Capuchins (*Cebus monachus*) from South-east Brazil, a Negro Tamarin (*Midas ursulus*) from Guiana, two Grant's Zebras (*Equus granti*) from North-east Africa, four Hutchin's Geese (*Bernicla hutchinsi*) from Arctic America, six Dark-green Snakes (*Zamenis gemonensis*), two Lacertine Snakes (*Coelpeltis monspessulana*), a Vivacious Snake (*Tarbophis fallax*), European, deposited.

OUR ASTRONOMICAL COLUMN.

NEW SPECTROSCOPIC BINARIES.—In a paper communicated to the Astronomical and Astrophysical Society of America Profs. Frost and Adams announce the discovery of six stars of the Orion type having variable radial velocities, and two or three stars of the same type which are supposed to be spectroscopic binaries.

Of the former, δ Ceti shows a range of velocity from +6 to +16 km. per second, and its period is short; the velocity of ζ Tauri has a range of +7 to +34 km. per second, and a probable period of about fourteen days; the spectrum of this star is rather peculiar, in that the hydrogen lines β and γ are sharp and strong, whilst the other lines (some of them metallic) are faint. In the case of υ Eridani a variation in the velocity of + 3 to +26 km. per second is indicated.

Two or three other stars of the Orion type are suspected of having variable radial velocities, but the facts are not yet fully established. The proportion of spectroscopic binaries found amongst the stars of this type which have hitherto been examined is 1 : 5 (*Science*, n.s., vol. xvii. No. 426).

THE SPECTRUM OF COMET 1902 *b*.—In a communication to the March *Bulletin de la Société de France*, M. de la Baume Pluvinel discusses the spectra of comet 1902 *b*, which he has obtained, using a prism of 20° 18′, mounted in front of an objective the focal length of which was four times its aperture.

In a spectrum obtained on October 24, with one hour's exposure, the positions of fifteen condensations (*i.e.* images of the comet) were found to be measurable; the spectrum of Vega was photographed on both sides of the cometary spectrum as a comparison.

Two condensations at λ 472 and λ 389 respectively were found to be by far the strongest, these radiations evidently accounting for almost all the actinic light emitted by the comet, and, therefore, in photographing such objects it would be advisable to use an objective which brings these two radiations to the focus simultaneously.

Of the other condensations measured, the most important one extends from λ 409·2 to λ 400·0, and was far more intense on a negative obtained on October 13, when the comet was at a greater distance from the sun, than on the one obtained on October 24.

The conclusion arrived at from the detailed examination and discussion of the spectrum is that in the light emitted by this comet occur (1) the chief radiations emitted by carbon in the electric arc, viz. λ 564, λ 518 and λ 472 belonging to the spectrum of hydrocarbons, and λ 389 belonging to the cyanogen (?) spectrum; (2) the radiation λ 431·2, which appears in the flame spectra of the hydrocarbons; and (3) a group of radiations, λ 409·2 to λ 400·0, which corresponds to no carbon group.

MISSING ASTEROIDS.—In *Circular* No. 69 of the Harvard College Observatory Prof. E. C. Pickering directs attention to the fact that of the five hundred minor planets already discovered, sixty-eight have not been observed for the last five years, and the last observations of about twenty-five of them were made from ten to thirty years ago. He then proceeds to point out the danger that may arise from allowing these objects to remain unobserved, and their elements and ephemerides uncomputed, for an observer can never be certain whether the object he is observing is a new discovery or not, and so might pass over such an object as Eros, supposing it to be one which had been recorded previously.

Prof. Pickering concludes that it is a much more important work to rediscover all those minor planets previously recorded and determine their elements than to go on adding to the list by the discovery of new ones. Acting on this conclusion the Harvard observers prepared a list of all the asteroids, brighter than the eleventh magnitude, which have not been observed during the last five years, and have already photographed (21) Lutetia and (22) Kalliope (on plates obtained on January 21 and 22), which were last observed in 1897 and 1896 respectively, and they find that the error of the ephemeris given for the latter is large enough to render the finding of this object a difficult matter.

A RICH NEBULOUS REGION IN THE CONSTELLATION LYNX.—Whilst pursuing a photographic search for the minor planet (475) Occlo with the Bruce telescope, Prof. Max Wolf has discovered from his plates a region situated on the borders of Ursa Major and the Lynx which is especially rich in small nebulous patches. One particularly dense region is about the point α=8h. 2m., δ=+46°·5 (1855), the centre lying between the two stars B.D.+48°.1366 (8·5m.) and B.D.+48°.1368 (8·4m.), where, in a circle having a radius of thirty minutes of arc, he was able to count at least forty small faint nebulæ.

Two of the nebulæ, having the positions α=8h. 3·0m., δ=+46° 25′ and α=8h. 3·7m., δ=+46° 9′ respectively, are worthy of particular notice. The first was observed by W. Herschel, and appears in his catalogue as iv.,55. It is bright, apparently round, has a diameter of about 1′ and several condensations, and should appear as a beautiful object in a large reflector.

So far as Prof. Wolf is aware, the second has hitherto not been recorded. It has a length of about 3·5 minutes of arc, is rectilineal and very narrow, and is moderately bright. It includes in its northern boundary a faint star the position angle of which is 350°, and lies about 1′ west of the star B.D.+46°.1371 (9·3m.) (*Astronomische Nachrichten*, No. 3847).

THE BIRDS OF BEMPTON CLIFFS.

A VERY interesting and beautifully illustrated account of the birds frequenting the chalk cliffs of Bempton, Yorkshire, and of the egging industry carried on by the natives, appears in part i. of the *Transactions* of the Hull

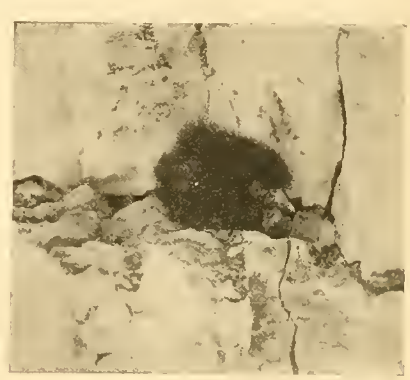


FIG. 1.—Newly-hatched Puffin. (From the "Birds of Bempton Cliffs.")

Scientific and Field Naturalists' Club. The author, Mr. E. W. Wade, commences by waxing enthusiastic over the wonderful sight presented by these precipitous cliffs when they are visited, in spring and summer, by swarms of sea-birds, among which guillemots are now predominant. In

former days the bird-life appears, however, to have been even more abundant than at the present day, this being especially the case with regard to kittiwakes, which were once found in thousands where there are now hundreds. So numerous, indeed, were these birds that there is a record of the heaps of twitch left in a field on a Saturday to be carted on the Monday having been carried off in the meantime by the gulls for nest building. The usual ruthless massacres of the old days were, however, responsible for so reducing the numbers of these birds that they were well-nigh exterminated by the time the Protection Acts once more gave them a chance.

After referring briefly to the puffin and the razorbill, accompanying his notice of the former by an excellent figure of a young bird (herewith reproduced), the author treats in considerable detail of the breeding habits and eggs of the guillemot. Attention is called to the number of young ones and eggs which are destroyed by falling down the cliffs when the birds are suddenly frightened, the author expressing his belief that a guillemot will intentionally roll its egg from the ledge on which it rests if she thinks it is about to be carried off. The remarkable variation displayed by guillemot eggs naturally claims a share of attention, although the author confesses that he is unable to give any reason for the phenomenon. In this connection it may be

FIG. 2.—A descent in search of eggs. (From the "Birds of Bempton Cliffs.")

mentioned that a magnificent series of these eggs, showing nearly all the chief types of variation, has recently been placed on exhibition in the Natural History Museum.

Cliff-climbing in Yorkshire is always effected by means of ropes, the author describing it as the most delightful and exciting form of gymnastics. Judging from the illustration here reproduced, some of our readers might think it a trifle too exciting. At the present time from 300 to 400 eggs are collected daily during the season, the total take being about 130,000. In spite of this drain the numbers of the birds annually increase. The price of the eggs varies from twelve to sixteen a shilling, abnormally marked specimens fetching from *2d.* to *7s. 6d.*, or even more, each. R. L.

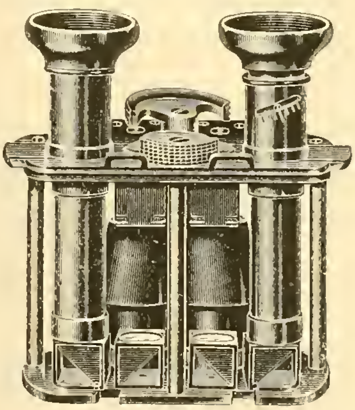
A NEW BINOCULAR.

A NEW form of prismatic binocular, styled the "Service," has recently been issued by Messrs. J. H. Dallmeyer, and there are many interesting features about it for which special advantages may be claimed. As a rule, binoculars consist of two independent optical trains in separate coverings, either hinged together to allow for the different gauges between the separation of human eyes, or made in different sizes to suit these various distances. In the present form the whole optical arrangement is enclosed in one cover, and in consequence of this, six out of the eight prisms employed and the two objective sliding tubes can all be fixed rigidly to one frame, thus ensuring maintenance of adjustment and strength in adverse circumstances.

The separation of the eye-pieces is secured by a screw adjustment situated between them, by which each eye-piece with one prism slides in strong grooves in a lateral direction. For any one individual this adjustment is constant, so that when once the correct position has been attained a permanent mark can be made, and this position quickly regained at any other time; the maximum separation between the centres of the eye-pieces is 70 mm. and the minimum 55 mm., so plenty of latitude is available for abnormal eyes.

There is another screw adjustment for the ordinary focusing, and one of the eye-pieces can be separately adjusted by means of a graduated spiral movement in case the observer's eyes are not similar. All these different manipulations can be easily made when only one hand is available, and the whole mechanism can be fully exposed for cleaning the optical surfaces by simply taking out four screws which in no way interfere with any of the adjustments.

Constructed chiefly of magnalium, and in parts of gun-



metal, the glasses are light in weight, and it is claimed that they are smaller, power for power, than any other prismatic glass yet made. There are five sizes on the market varying in magnifying power from four to twelve times, the former weighing thirteen and the latter sixteen ounces; the smaller sizes are suitable for theatre or night use.

SEISMOLOGICAL NOTES.

THE last publication of the Earthquake Investigation Committee of Japan, issued this year, is of special interest to those engaged in seismometry. In it Prof. A. Tanakadate describes a vertical motion seismometer, in which a mass is so suspended that it is not affected by tilting or by horizontal shocks, and remains in neutral equilibrium for vertical displacements of considerable magnitude. Until this instrument was devised, for large earthquakes at least, vertical spring seismographs, and for that matter horizontal bracket seismographs, have responded to the changes in inclination of their supports, with the result that they have

behaved as clinographs, and components of vertical and horizontal movements have not been faithfully recorded. Mr. Imamura gives results relating to the speeds at which earthquake motion has been propagated over the Tokio area. At four stations, from 2 to 10 kilometres apart, and connected by telegraph, seismographs were arranged each of which gave an open diagram on a surface marked by time intervals sent from the Seismological Institute. From the differences in time at which the same wave was recorded at different stations, the speed of that wave was determined. The surface velocity arrived at is that $V = 3{\cdot}28 \pm 0{\cdot}05$ kilometres per second, but as to whether different waves in the same earthquake travel with the same speed, which we think is not the case, we are left in darkness. In a paper on after shocks, Prof. Ōmori shows that the expected or calculated number of such settlements for a given period closely accords with observation. By maps and diagrams he also shows the space distribution of after shocks, there being, as might be expected, fewer of these disturbances recorded at places distant from a *focus* than at those comparatively near.

In a paper on pendulum seismographs (*Bollettino della Societa Sismologia Italiana*, vol. vii.) Dr. Agamennone eulogises the work of the Seismological Society of Japan for the revolutionary effect it has had upon seismometry. For 130 years prior to the existence of this Society the ordinary instrument employed to record earthquakes was a vertical pendulum. Subsequently horizontal pendulums were used, and seismometers took the place of seismoscopes. The results which have been achieved by the new types of instruments as recorders of movements that can be felt are well known, but the value of the records relating to earthquake motion which has radiated to great distances, beyond timing certain phases of motion, is very doubtful.

The horizontal pendulum largely used in Germany, Austria and Russia, when recording on slowly moving photographic paper, has been referred to as a species of delicate seismoscope. To some extent this may be true, but yet it records certain phases of motion, and frequently picks up small disturbances which are not recorded by more cumbrous forms of apparatus. In his paper Dr. Agamennone gives three seismograms obtained from ordinary pendulums, respectively 16, 8 and 3 metres in length, written upon surfaces moving at rates of from 20 to 40 metres per hour. Such seismograms show the earthquake vibrations superimposed upon those due to the swinging of the pendulums. For recording earthquakes at great distances from their origins, Dr. Ōmori not only advocates the use of quickly moving surfaces, but that a horizontal type of pendulum should be employed the period of which should be long. On account of the diurnal and other wanderings of such a pendulum, for most foundations this period is, however, limited to about thirty seconds.

Other seismologists have also suggestions, and when it is remembered that in a given earthquake continuing for several hours there are groups of waves with periods varying between a fraction of a second and a minute, it is easy to imagine that this should be the case.

In short, so far as the recording of the period and amplitude of unfelt earthquakes are concerned, seismologists are not in step, and until opinions are less divided, which is not likely to be the case until more experiments have been made, to impose a type of instrument upon the world for the purposes specified seems likely to prove detrimental to seismometrical inquiry.

In the last issue of the *Bollettino* of the Seismological Society of Italy, vol. viii. No. 6, M. Alippi gives a short paper on subterranean sounds. The mysterious detonations heard in Holland and on the shores of the North Sea known as *mist poeffers* are atmospheric phenomena. These, which may be the same as the sounds called *barisal guns*, must not be confounded with sounds originating in the earth. These latter, which by no means necessarily accompany earthquakes, are in Italy referred to as *rombo, bombio, bonniti* and other expressions clearly of onomatopoetic origin.

The remaining pages of the number contain the seismic register of Italy for March and April, 1901. The late appearance of this register is on account of the fact that it practically includes all observations made upon earthquakes which have been recorded in the Italian peninsula, and as these include world-shaking disturbances, the collection of material from foreign countries occupied considerable time.

As this publication stands *facile princeps* amongst its kind, Prof. Pietro Tacchini and his staff are to be congratulated on their useful work.

THE NEW BIOLOGICAL STATION AT PORT ERIN.

THE sixteenth annual report of the Liverpool Marine Biology Committee,[1] which records the completion and occupation of the new buildings at Port Erin, opens a fresh period in the history of this Committee, which was constituted in March, 1885, at a public gathering of the local naturalists from Liverpool, Manchester, Southport, Chester and the neighbourhood, summoned by Prof. Herdman for the purpose. The declared objects were "to investigate the marine fauna and flora (and any related subject such as submarine geology and the physical condition of the water) of Liverpool Bay and the neighbouring parts of the Irish Sea, and, if practicable, to establish and maintain a biological station on some convenient part of the coast." These ends have been kept steadily in view for the last seventeen years. At an early stage of the investigations, in 1887, the Committee established a small biological station on Puffin Island, off the north coast of Anglesey, and during the next five years this laboratory was kept up, and dredging and other exploring expeditions were carried on from it.

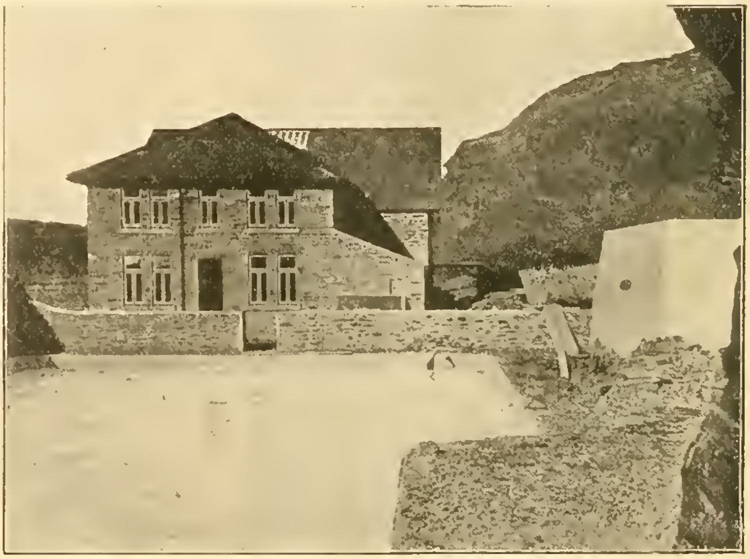


FIG. 1.—Western End of Station, showing Spawning Pond and Hatchery Entrance.

Then the centre of the Committee's field work was transferred from Anglesey to the Isle of Man—"from the Mona of Tacitus to the Mona of Cæsar." Here a small biological station was built on the northern side of Port Erin Bay and was formally opened for work on June 4, 1892, by Sir Spencer Walpole, then Governor of the island. Notices of the work carried on in this laboratory and of the dredging expeditions in the Irish Sea

[1] Liverpool: Tinling and Co., December, 1902.

during the last ten years have appeared from time to time in the pages of NATURE.

The alliance between a committee appointed by the Manx Government and the Liverpool Committee, which has now resulted in the provision of a much larger biological station on a better site at the southern side of Port Erin Bay, had its origin in the sea-fisheries work carried out on an experimental scale in the old station for the purpose of obtaining information for the Lancashire Sea-fisheries Committee.

The details of the arrangement concluded between the Manx and Liverpool committees are given in the report. It may suffice to say that the two committees have evidently worked most harmoniously together, and will no doubt continue to cooperate cordially and usefully. Of the three departments in the institution, the laboratory block will be wholly under the control of the Liverpool Committee, the fisheries block will belong solely to the Manx Committee, and the aquarium in the centre will be managed as a joint concern in the interests of both the scientific and economic work. The curator of the old biological station (Mr. H. C. Chadwick) has become curator of the whole institution, with a practical fisherman assistant under him, and the hon. director and chairman of the Liverpool Committee (Prof. Herdman) is recognised as being director also of the whole. This should secure unity of aim and

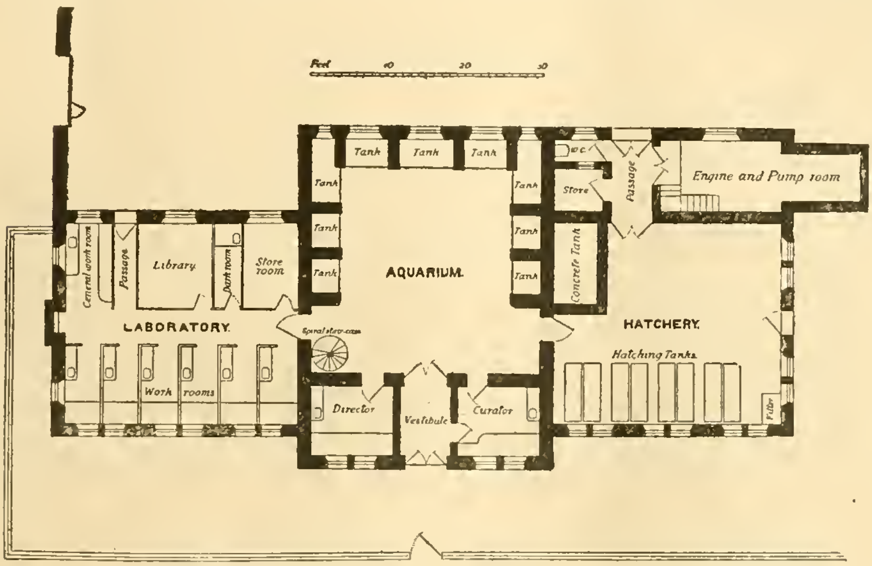


FIG. 2.—Plan of Ground Floor of Station.

economy of working, and will result in the various departments being mutually helpful. The fishery work will be instructive to the scientific students, and the investigations in the laboratory and experiments in the aquarium will be useful in connection with fishery problems. The aquarium, which, with its museum of local marine animals and plants in the gallery, occupies the large central block of the building, is the only part open to the public, and will, it is hoped, be useful alike (1) to the scientific workers in the laboratory, (2) for experiments and observations bearing on fishery questions and practice, and (3) as an educational influence which will be appreciated by the more intelligent visitors, and may, it is hoped, be taken advantage of by local schools for instruction in nature-study.

The station is a plain but substantial two-storied stone building of nearly 100 feet in length by more than 40 feet in breadth, with a light railing in front and a large yard, enclosed by a wall, behind. At the western end (Fig. 1) is a large pond excavated in the rock, measuring about 90 feet in length, nearly 50 feet in breadth, varying from 3 to 10 feet in depth, and capable of containing about 130,000 gallons of sea-water.

The plan (Fig. 2) shows the division of the building into a central aquarium and lateral laboratory and fisheries wings, and gives the arrangement of the rooms on the ground floor. The upper storey has a broad gallery round the aquarium and large laboratories in the wings. Of the six small workrooms to the front on the ground floor, four are now permanently engaged by universities, leaving two still vacant. The junior laboratory on the floor above, it is announced, will be occupied by a class for school teachers during the Easter vacation.

For the information of students and other naturalists who may propose to visit the new biological station, it may be wel to state that Port Erin is at the south-west end of the Isle of Man and occupies a fairly central position in the Irish Sea, being about 30 miles from Ireland, 33 from Scotland, 40 from Wales and 45 or so from England. The bay faces nearly due west, has sand at the end, and is bounded by precipitous cliffs both to the north and south. From its position and the shape of the land, Port Erin has within a distance of a couple of miles in three directions—to Fleshwick Bay, to the Calf Island and to Port St. Mary—a long and varied coast line with a number of small bays furnishing good collecting ground and shallow water for dredging. Two of these bays, Port Erin and Port St. Mary, have harbours with sailing boats and face in nearly opposite directions, so that in most winds one or other is sheltered and has a quiet sea.

The rich fauna round the Calf Island and off Spanish Head is within easy reach; while at a distance of three to four miles from the biological station are depths of 20 to 30 fathoms, and at 14 miles 60 to 70 fathoms depth is found.

The aquarium of the new station was opened to the public in the middle of August, and in October more than six hundred visitors had already paid for admission.

The report from which these remarks are extracted gives also an account of the scientific work undertaken by the Committee during the last year and records many additions to the local marine fauna, chiefly amongst the microscopic crustaceans worked out by Mr. A. Scott.

The report points out, finally, that while the change to the new building is advantageous in giving better accommodation and larger opportunities, it also gives increased labour and responsibility and in no way relieves the Liverpool Marine Biology Committee of financial burdens. The Committee retains its identity and constitution exactly as before, and the subscriptions from those who are kindly supporting the work will be required fully as much in the new building as they were in the old. The Manx Government subsidy will be entirely applied to the economic work in connection with the local sea-fisheries and will not be available for the purely scientific work of the biological station.

BOTANICAL NOTES.

UNDER the title of "Vegetationsbilder," Messrs. Gustav Fischer, of Jena, announce a series of photographic reproductions which will illustrate characteristic types of vegetation. Each part, consisting of six plates and the explanatory text, will be devoted to one region or formation, and will be complete in itself. The photographs were taken by Drs. Schenck and Karsten, who undertake the arrangement of the work. The first and second parts now received depict the scenery of South Brazil and of the Malay Archipelago; other parts of the eight projected will illustrate botanical features of South-West Africa, Mexico, tropical economic plants, &c. The photographs are reproduced nearly full-plate size, and recall the illustrations of Schimper's "Pflanzengeographie," which is published by the same firm.

The Yorkshire Naturalists' Union is fortunate in enlisting the services of specialists to assist in the compilation of county records, both botanical and zoological. Several series representing different branches of natural history have been, and are being, published in its *Transactions*. One part, lately issued, completes the county list of fresh-water algæ, which has appeared in four instalments, and for which Mr. W. West and Mr. G. S. West are responsible. Another volume, which is produced under the joint authority of Mr. G. Massee and Mr. C. Crossland, constitutes the first instalment of the "Fungus Flora of Yorkshire," and enumerates the Gasteromycetes and Agaricineæ. Although only a small portion of the county has been thoroughly explored, the list will summarise the results obtained during several successive annual forays, and will also include the records noted by independent collectors.

At the meeting of the American Association held in Washington last December, Prof. Douglas Campbell selected as the subject of his address "The Origin of Terrestrial Plants." The subject is one to which the writer has contributed many valuable suggestions and arguments, but on the present occasion no new ideas are presented. It may be noted that although Prof. Campbell alluded to the possibility of the leaf arising by mutation as a sudden outgrowth on the sporophyte, he looks upon the apophysis of the moss capsule as an early form of such emergence. With regard to the origin of the root, the view is expressed that this arises as a modification of the foot.

A list of fresh-water algæ, collected in Java by Dr. Raciborski, and named by Mr. M. R. Gutwiński, appears in the *Bulletin International de l'Academie des Sciences de Cracovie*. Sixteen new species are recorded under the genera Closterium, Penium, Xanthidium, Cosmarium, Staurastrum and Spirulina.

A small brochure, published by the University College of Wales Scientific Society, furnishes a list of flowering plants and ferns which have been found in the neighbourhood of Aberystwyth. The compilation of such records is to be strongly commended, since it furnishes a definite objective, and is therefore certain to provide an extra stimulus for the excursions of local societies. The list now produced may, with advantage, be amplified by inserting notes on habitats, dates and descriptions of peculiar forms.

The first specimen-part of the "Prodromus Floræ Britannicæ" was issued by the author, Mr. F. N. Williams, in June, 1901, and since that date two more numbers have been published, the last bearing the date November, 1902. The orders Cucurbitaceæ, Lobeliaceæ and Campanulaceæ appeared in the first portion, while the remainder of the work, so far as it goes, is devoted to the Compositæ, under the disguised name of the Asteraceæ, and the last part is given up to and contains the whole of the genus Hieracium.

The presidential address on the "Rise and Progress of Ecology," delivered by Prof. V. M. Spalding before the Society for Plant Morphology and Physiology at the Washington meeting, appears in *Science*. The writer indicates two phases of the subject, the compilation of facts and the subsequent incorporation of these into conclusions, and refers to a recent paper, by Mr. Paul Jacquard, on alpine plants.

The Annual report of the Board of Agriculture and Department of Public Gardens in Jamaica, for the year 1901-2, also an authorised Guide to Hope Gardens, have been received. In the former certain changes in the disposition of the staff are recorded, and also the approval of the legislative council for the purchase of land on St. Jagos estate, part of which may possibly be utilised for experimental work. A survey is given of horticultural experiments and educational work. The Guide includes a description of the botanic gardens by Mr. W. Jekyll.

In the current number of the Trinidad *Botanical Bulletin* there appears an instructive article on the care of pastures. It is pointed out that native grasses are likely to be more successful than those grown from imported seed, or if imported they may with advantage be introduced from countries which possess a similar climate. For the destruction of parasol ants, carbon bisulphide, used with due precaution, is recommended. In connection with this and other uses, such as a seed fumigator, an article giving American experience is reprinted.

THE PREVENTION OF DEW DEPOSITS ON LANTERN SLIDES.[1]

LANTERN slides are so commonly used in lecture illustrations that the following hints may prove to be useful:—

The deposit of dew which frequently takes place is very annoying, but its cause is easily traced, and, I believe, can easily be removed. Dew means that the surface on which it is deposited is colder than some other surface with which the air must have previously been in contact, and at which it has become saturated with moisture; hence the problem consists in discovering that surface, and in preventing its becoming hotter than the glass slide.

There is a kind of tradition amongst makers of lanterns and their accessories that every surface should be black. There is no reason at all for this practice, which is probably in all cases the cause of the trouble I am dealing with. My attention was called to the subject by a lantern used for the projection of objects much larger than the ordinary slides. When these were used, they were put in a wooden frame which presented a large carefully blackened surface to the condenser. The condenser always became quickly covered with dew. On pasting a sheet of white paper over the blackened wood of the frame which held the slides, the trouble was at once removed. What had happened was that the black wood became heated, and gave up a large amount of moisture. When covered with a white reflecting surface, on the other hand, the heating was sufficiently reduced to prevent the distillation of moisture. The deposit of dew on the condenser lenses may therefore easily be avoided.

More troublesome is the dew which forms in the space between the photographic picture and the glass cover of the slide. I have not personally been troubled with this, and therefore I have not had any experience as to how to get rid of it, but I feel sure that a great deal could be done by removing the blackened paper frame which is generally inserted between the two glasses, and replacing it by tin foil or white paper. It is obvious that if we take care that the glass of a slide forms the hottest surface in the neighbourhood, no dew can be deposited on it. As the glass absorbs a good deal of the more intense rays, and the slide itself is appreciably warmed, there should be no trouble in securing that nothing else should get warmer. The only possible cause which could not be dealt with would be the evaporation of water from the silver deposits which form the photographic picture, but there is no reason to suppose that they condense a sufficient amount of moisture to do much mischief if the slides are carefully dried to begin with.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR MICHAEL FOSTER has resigned the chair of physiology at Cambridge, which he has held since 1883, when the professorship was established.

PROF. J. A. EWING, F.R.S., professor of mechanism and applied mechanics in the University of Cambridge, has been appointed Director of Naval Education, under the new scheme of training. The scheme was discussed in connection with the Navy Estimates on Monday, and an amendment disapproving of it was moved, but upon a division the amendment was rejected.

THE Liverpool Marine Biology Committee has, in consultation with the Nature-Study Association of Teachers of Liverpool, issued a circular expressing its willingness to make arrangements for a special class in elementary marine biology, to illustrate the principles of nature-study, and to be held at the Port Erin Biological Station during the Easter holidays. The course will extend from April 10–17. Intending students should communicate with Mr. F. J. Cole, University College, Liverpool.

AT the annual meeting of the National Home-Reading Union on March 13, Dr. Richard Garnett delivered an address in which he dealt with the community of aim and feeling between the Union and the public library system. One great wish of the Union is through the systematic

[1] Read at the British Association Meeting in Belfast, September, 1902, by Prof. Arthur Schuster, F.R.S.

inculcation of good reading habits and the systematic dissemination of superior literature, not merely to make this literature better known, but to create an atmosphere in which—except in the case of thoroughly inferior minds—inferior literature will not be able to exist.

In 1901 a central committee was formed in Berlin for the purpose of organising gratuitous post-graduate courses in medical science throughout Prussia. This committee, of which Prof. von Bergmann is the chairman, has now instituted such courses in twenty-three towns, and has acquired a collection of medical books and instruments to be lent to the local committees in small places where such means of instruction are not sufficiently available. A building, to be called the Empress Frederick House for Post-graduate Training, will be erected in Berlin to serve as the headquarters of the organisation in Prussia. The Emperor has expressed complete approval of the plans of the committee.

The eleventh annual report for the year 1902 of the Technical Instruction Committee of the City of Liverpool shows an increase of 1040 in the number of registered students of the evening science, art and technological classes. The total number of entries to the classes held at the Central Technical School was 3625. This increase is to be attributed in some measure to an exhibition of students' practical work held just before the commencement of the session, and it is in contemplation to continue the exhibition and extend it to other centres. The establishment of a day technical school in the central school building, and of improved local buildings in the south end and on the east side of the city are still under consideration. The report also shows that the City Council has devoted to educational purposes the whole of the amount received under the Local Taxation (Customs and Excise) Act, 1890, with the exception of a sum of 7000*l.* paid to the credit of the City fund in 1892. The total amount thus allocated to educational purposes during the twelve years, 1890–1902, is 225,450*l.* 19*s.* 4*d.*

The platitudes often expressed by speakers on educational subjects, and the verbose character of the larger part of educational literature, are responsible for the suspicion and want of respect with which many practical teachers regard any attempts to construct an educational science. What is wanted at the present time is a centre where the aims and practice of education can be studied without the limitations of traditional doctrines, and with modern requirements well in mind. The University of Birmingham seems to offer an opportunity for work of this kind in connection with the new chair of education, for which applications are invited. In the particulars issued to candidates for the post we read :—" The University believes that the improvement of education in England is a vital matter, and that the present post offers attractive opportunities to a man of influence and ability who is willing to cope with the difficulties of the task. Such a man would meet with cordial cooperation and assistance, and might be able to accomplish a worthy piece of work." The professor will be required to take control of the training of secondary teachers and to organise the inspection and examination of secondary schools. It should thus be possible for the successful candidate to establish a system of training of teachers in the science and art of education which would have a decided influence upon the work of secondary schools.

A conference of representatives of county and county borough councils was held on Tuesday, under the auspices of the National Association for the Promotion of Technical and Secondary Education, to consider the question of higher education. Lord Avebury presided, and the following resolutions were adopted :—(1) That this conference of representatives of local authorities and educational bodies recognise the great importance of suitable, adequate and systematic provision being everywhere made for the supply of facilities for higher education by means of continuation schools, secondary schools, technical institutes, and classes, and by access to the universities, such facilities to include a sufficient number of scholarships and exhibitions, and, where suitable funds exist, to provide for a post-graduate course and the endowment of original research ; (2) that every effort should be made to secure proper cooperation between local authorities and educational bodies in promoting higher, including university, education ; (3) that it is urgently necessary for the improvement of education that more suitable means should be provided for the training of all grades and classes of teachers. Mr. J. Bryce, M.P., was one of the speakers, and in the course of his remarks train for the universities ; and in towns of 100,000 people what they might call a grammar school, providing the elements of technical instruction ; in towns of 40,000 or 50,000 population there ought to be a school competent to train for the universities ; and in towns of 100,000 people there should be a completely equipped technical institute to fit boys for a science profession and for the pursuit of science. He added that in towns of 300,000 there should be a university college.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xxv. No. 1, January.—D. N. Lehmer, parametric representation of the tetrahedroid surface by elliptic functions. Various properties of the singular points, lines and planes.—E. B. Skinner, on ternary monomial substitution-groups of finite order with determinant ± 1. All the groups can be got from three generators or less, one of order two, and conversely.—V. Snyder, forms of sextic scrolls (two papers). There are sixty-eight types of such scrolls which are unicursal, and thirty-two of genus 1.—E. D. Roe, note on symmetric functions.—A portrait of Cremona accompanies this part.

Annals of Mathematics (2), vol. iv. No. 2, January.—J. W. Bradshaw, the logarithm as a direct function (with introduction by W. F. Osgood).—P. Saurel, positive quadratic forms.—E. A. Hook, multiple points on Lissajous's curves in two and three dimensions.—C. C. Engberg, a special quadri-quadric transformation of real points in a plane ($x=x'$, $y=\pm\sqrt{x'^2+y'^2}$).

Bulletin of the American Mathematical Society (2), vol. ix. No. 5, February.—W. F. Osgood, transformation of the boundary in conformal mapping.—V. Snyder, quintic scroll with three double conics.—L. P. Eisenhart, surfaces referred to their lines of length zero.—E. R. Hedrick, note on calculus of variations.—E. B. Wilson, synthetic treatment of conics at the present time. The author (very properly) emphasises the value of v. Staudt's methods.—Reviews : Brown's " Lunar Theory " (F. R. Moulton), Geissler's " Die Grundsätze u. das Wesen des Unendlichen " (E. R. Hedrick), recent German text-books in geometry (P. F. Smith).

Bulletin of the American Mathematical Society (2), vol. ix. No. 6 (March).—L. E. Dickson, the abstract group isomorphic with the alternating group on six letters.—H. F. Blichfeldt, property of conics.—R. W. H. T. Hudson, analytic theory of displacements.

Transactions of the American Mathematical Society, vol. iv. No. 1 (January).—F. Morley, orthocentric properties of the plane n-line.—L. E. Dickson (two papers), definitions of a field by independent postulates ; definitions of a linear associative algebra.—E. V. Huntington (two papers), definitions of a commutative group and of a field.—C. N. Haskins, invariants of differential forms of degree higher than two.—A. Loewy, reducibility of groups of linear homogeneous substitutions.—A. B. Coble, the quartic curve as related to conics.—E. Kasner, cogredient and digredient theories of multiple binary forms.—R. E. Allardice, envelope of axes of conics through three fixed points.—W. F. Osgood, a Jordan curve of positive area.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 19.—" The Evaporation of Water in a Current of Air." By Dr. E. P. **Perman.** Communicated by Prof. E. H. Griffiths, F.R.S.

The object of this investigation was to discover with what accuracy the vapour-pressure of water could be calculated from the amount of water vapour carried off by an air current passed through the water, the temperature being maintained constant. The method adopted was to aspirate air, at a rate of not more than 0·1*l.* per minute, through

a succession of wash-bottles containing water and placed in a thermostat. The water carried off by the air was absorbed by means of concentrated sulphuric acid and weighed. The results obtained show in every case a close agreement between the calculated vapour-pressure and that commonly accepted. Experiments were made at temperatures varying from 20° to 90° C. It may be concluded from this that in air saturated with moisture (under the conditions used in the experiments) the pressure of the aqueous vapour is the same as the vapour-pressure of water when no other gas is present, also that the density of the aqueous vapour in the mixture is normal. It follows also that the density of saturated aqueous vapour, *without* admixture of any other gas, is approximately normal. This conclusion is confirmed by calculations of the density from the thermodynamical equation $L = T/J(s'-s)dp/dT$, using Griffiths's values of L and J and the latest determinations of vapour-pressure at the Reichsanstalt for the values of dp/dT.

Mathematical Society, March 12.—Dr. E. W. Hobson, vice-president, in the chair.—Mr. G. H. **Hardy**, On the convergence of certain multiple series. The paper contains an investigation of the analogue for multiple series of a theorem (due to Abel) concerning the partial summation of simple series. Most of the ordinary tests of convergence for simple series are founded on this theorem. Proofs of convergence of certain classes of multiple series are obtained, in particular of the class in which the general term is of the type

$$(b_1r_1 + b_2r_2 + \ldots + b_nr_n)^{-\mu} \exp \iota (a_1r_1 + a_2r_2 + \ldots + a_nr_n).$$

—Mr. S. M. **Jacob**, On certain sequences for determining the nth root of a rational number. The paper contains a systematic development of a method used by Dedekind (in the case of the square root) to obtain sequences of the kind in question. If D is any rational number, and x is a rational approximation by excess or defect to the nth root of D, it is shown how to construct a rational number y which lies between x and the nth root of D.—Prof. H. **Lamb**, Note on the approximate calculation of the frequencies of a vibrating circular plate. The method of Rayleigh ("Theory of Sound," § 88) is applied to calculate the frequencies of the gravest modes of vibration of a plate by means of the assumption of very simple hypothetical types. The agreement of the results with those calculated by Kirchhoff from the exact equation for the frequencies is remarkably close.—Prof. A. R. **Forsyth**, On surfaces which have assigned families of curves as their lines of curvature. The paper contains a new method of investigating the conditions that a given family of curves may be the lines of curvature of a surface, and of determining the character of the surface from that of the lines. The method is illustrated by the example of Dupin's cyclide.—Mr. E. T. **Dixon**, Note on a point in Hilbert's "Grundlagen der Geometrie."—Mr. J. H. **Grace**, Extension of two theorems on covariants.—Prof. T. J. I'A. **Bromwich**, Note on double limits and on the inversion of a repeated infinite integral. The object of the note is to determine the conditions which are necessary and sufficient for the change of order of integration in an integral with infinite limits, and for the existence of a double integral with such limits. The continuity of a definite integral with infinite limits, considered as a function of a parameter contained in the subject of integration, is discussed.—Prof. W. **Burnside**, On the representation of a group of finite order as an irreducible group of linear substitutions, and the direct establishment of the relations between the group characteristics. The paper deals with the representation in question from a self-contained point of view, without introducing considerations which are foreign to the conceptions of an abstract group of finite order and of a group of linear substitutions. The arrangement of the subject from this point of view is materially different from that in previous discussions of it. The complete reducibility of a group of linear substitutions of finite order is taken first, the number of distinct irreducible representations and the composition of them follow, and the group-characteristics and their properties occupy the last place.

Geological Society, February 20.—Prof. Charles Lapworth, F.R.S., president, in the chair.—Annual General Meeting.—In his anniversary address the president dealt with the relation of geology to its fellow-sciences. In the course of the address the president remarked that the study of geology shows that the corporate geological organism has three necessary functions—research, practice and education. So long as all three functions are naturally and healthfully performed, so long will geology live and flourish. The work and influence of Werner and De la Beche show that the progress of the science is at its swiftest and surest when none of the three functions suffer from disuse.

February 25.—Prof. Charles Lapworth, F.R.S., president, in the chair.—On the occurrence of Dictyozamites in England, with remarks on European and eastern floras, by Mr. A. C. **Seward**, F.R.S. The specimens described as a new species of Dictyozamites were obtained from a bed of ironstone on the northern face of the Upleatham outlier, near Marske-by-the-Sea. The genus is also found in the Rajmahal Series of India, in Central Japan and at Bornholm. Its probable taxonomic position is best expressed by placing it as a member of the Cycadophyta. A comparison of the Bornholm, Indian, Japanese and English floras is made, and a special list of these floras has been prepared, in which, while the names at present in use are indicated, it is pointed out where obscured identities or resemblances exist. The author concludes that there was a greater similarity between the vegetation of eastern and western regions, during part at least of the Mesozoic era, than is usually admitted. The most noteworthy exceptions are afforded by the Mesozoic representatives of the two isolated recent ferns Matonia and Dipteris; these two families—each with a surviving genus—played a conspicuous part in the vegetation of the Rhætic and succeeding Jurassic epochs in Europe, and to a less extent in North America, but there are no satisfactory records of their existence in India or Japan.—The amounts of nitrogen and organic carbon in some clays and marls, by Dr. N. H. J. **Miller**. Analyses of soils are given to show that decaying vegetable matter in soil tends to become more nitrogenous, on account of the greater ease with which gaseous compounds are formed with carbon than with nitrogen. Hilgard's experiments throw light on the effects of extreme conditions of climate, the amount of soluble humus being much greater in soils in humid than in arid climates. The large areas of peat-land known as "Hochmoor" contain larger proportions of carbon and nitrogen at depths of seven and fourteen feet than at the surface. The organic matter of soils is of two kinds—the humous portion and the bituminous, the latter being regarded as belonging to the original deposit from which the soil is derived. Analyses of soils and subsoils are given to illustrate this point. Further light on this subject is derived from the analysis of specimens obtained through the kindness of Sir A. Geikie from borings in the possession of the Geological Survey. Apart from the interest due to the great depths from which the samples were obtained, and the evidence which they afford of the enormous accumulations of combined nitrogen, they possess the further and greater value of representing the materials out of which large areas of soils have been derived. It would be important to determine, in the case of these older deposits, whether any of the organic matter at all is in the form of humus.

Zoological Society, March 3.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—A communication was read from Mr. E. R. **Sykes** on the operculate Land-Mollusca collected during the "Skeat Expedition" to the Malay Peninsula in 1899-1900. Fourteen genera were represented in the collection by examples of twenty-three species, eight of which were described as new.—Mr. R. **Lydekker** communicated a paper on the callosities of the limbs of the Equidæ, in which it was urged that the view of the callosities being vestigial foot-pads was untenable. The author maintained that they were probably decadent glands, and that possibly the one on the hind limb might correspond to the tarsal gland of deer.—Mr. Rudolf **Martin** read a paper on some remains of the ostrich, *Struthio karatheodoris*, found in the Upper Miocene deposits of Samos. The author stated that the existence of an ostrich in Samos was of interest, because a comparison of the fauna of Samos and that of the Siwalik Hills showed that the latter was younger, and consequently *S. karatheodoris* was of a greater geological age than *S. asiaticus*. The hypothesis, therefore,

that the family of ostriches had been developed in Southern Eurasia and emigrated at a later period to Africa and Southern Europe could not be sustained. The discovery of *S. karatheodoris* in Samos showed rather that the specialisation took place in Africa, and that the existence of such forms in India and Southern Europe was due to a secondary immigration from Africa. Most probably, however, there was the same relationship between the whole fauna of Samos and that of the Siwalik Hills—*i.e.* the latter was a transformed and later generation of the former.—Mr. F. E. **Beddard,** F.R.S., read a paper upon some species of Oligochæta from Africa.

Linnean Society, March 5.—Prof. S. H. Vines, F.R.S., president, in the chair.—Rev. T. R. R. Stebbing, F.R.S., exhibited a collection of spiders and wasps from Singapore, made by Mr. C. J. **Saunders.** (1) Spiders found in eleven clay cells built between the boards of a thin book standing upright on a book-shelf; the space $\frac{1}{4}$ inch broad by $\frac{1}{4}$ inch high, and $4\frac{1}{2}$ to 5 inches long. Mr. Saunders reckoned that each cell contained ten or eleven spiders and a single grub. He found a small fly in one cell, and others later in a different set of cells. He remarks that the Chinese must have noticed the spider-trapping habit, since they say of certain bees that they "adopt" spiders and bring them up as young bees. (2) Contents of another set of cells, built in a corner of the verandah, in two vertical rows, about thirteen cells in all. The spiders were all of one kind, fifty-six in number, with three half-eaten and two skins. (3) Contents of a set of cells, the topmost of which was closed while Mr. Saunders was examining other sets. The day before had been wet, but even the topmost cell, which was not yet dry, contained a grub. The exhibitor also remarked that in the family Crabronidæ or Sphegidæ, *Ammophila hirsuta*, a British species of sand-wasp, is said to provision its nest with spiders. The same habit has long been known in *Pelopoeus spirifex* (Linn.), belonging to the same family. Also in the family Pompilidæ, species of Pompilus are known to attack large spiders and make them a provision for their young ones. Latreille, in 1802, quotes a letter from Cossigny to Réaumur, describing the behaviour of *Pelopoeus spirifex* to spiders in the Isle de France. Latreille named the genus Pelopœus, the mud-worker, or potter.—On some points in the visceral anatomy of the Characinidæ, with an inquiry into the relations of the Ductus pneumaticus in the Physostomi generally, by Mr. W. S. **Rowntree.** The author summarised Sagemehl's observations on the skull of the Characinidæ, and then described his own investigations into the visceral anatomy of these fishes, derived from the examination of fifty-three species belonging to thirty-three genera, the chief interest of the paper centring in the author's observations on the position of the Ductus pneumaticus in relation to the alimentary canal, which observations had extended to other families of the Physostomi.—On the anatomy of the pig-footed bandicoot, *Chaeropus castonotis*, by Mr. F. G. **Parsons.**—Further notes on the lemurs, with especial reference to the brain, by Dr. G. Elliot **Smith.** This paper records observations supplementary to those recently published in the *Transactions* of the Linnean Society, and deals with two internal casts of imperfect crania of Nesopithecus recently acquired by the British Museum, two brains of young specimens of *Propithecus diadema*, and an adult brain of *Lemur macao*. The brain of Nesopithecus (Globilemur) is shown to present a curious mixture of pithecoid and prosimian features, and the author regards this genus as a specialised one, forming a connecting link between the lemurs and apes.

Entomological Society, March 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Colonel C. T. **Bingham** sent for exhibition specimens of Diptera and two Aculeates from Sikhim, showing in the banding of the wings and other characteristics a singularly beautiful case of mimicry. The Rev. F. D. Morice drew attention to the way in which the fly imitated with its tibia the tarsus of the bee.—Mr. A. J. **Chitty** exhibited specimens of the rare *Atomaria rhenana*, taken by him out of some food rubbish found near Lancing, probably the same locality where the beetle was discovered formerly by Dr. Sharp. He also exhibited a Ptinus, found in a granary in Holborn in 1893, apparently new to Britain and probably introduced.—Mr. W. J. **Kaye** exhibited species of Lepidoptera from British Guiana, forming a Müllerian association in which all but one were day-flying moths, the exception being an Erycinid butterfly, *Esthemopsis secina*. The particular interest of the exhibit consisted in the association being one of moths, a butterfly being the exception, and not one of butterflies with perhaps a single moth, which latter is so frequently the case in South America. The butterfly most closely resembled *Agyrta micilia*, one of the most abundant of the Syntomid group.—Mr. C. O. **Waterhouse** read notes on the nests of bees of the genus Trigona; Mr. G. A. Rothney communicated a paper on the Aculeate Hymenoptera of Barrackpore, Bengal, and descriptions of eighteen new species of Larridæ and Apidæ, from Barrackpore, by Peter **Cameron**; Colonel Charles **Swinhoe** communicated a paper on the Aganiidæ in the British Museum, with descriptions of some new species.

MANCHESTER.

Literary and Philosophical Society, February 17.—Mr. Charles Bailey, president, in the chair.—Mr. T. **Thorp** showed a copy of a Japanese magic mirror he had cast. He had had it ground and polished with a partial vacuum behind it, with the result that the reflection showed the design on the back of the mirror very distinctly. Mr. Thorp believed this to be the first mirror to be made in that way, and he afterwards presented the mirror to the Society. Mr. Thorp also exhibited a small apparatus for attaching to a gun to facilitate sighting.—Mr. W. E. **Hoyle** showed on the lantern screen a number of microscopic sections illustrating the structure of the luminous organs of a cuttle-fish which he had described to the Society during the previous session. Mr. Hoyle also read a paper entitled "Notes on the Type Specimen of *Loligo eblanae*, Ball," in which was demonstrated the identity of a squid from Dublin Bay, described by the late Dr. Robert Ball, with one recorded by M. Girard from the coast of Portugal and also found in the Mediterranean.

PARIS.

Academy of Sciences, March 9.—M. Albert Gaudry in the chair.—The general theory of translucency, by M. J. **Boussinesq.** A generalisation of the theory of gradual extinction of plane waves with pendular motions, given in a preceding note.—The preparation and properties of the hydrides of rubidium and cæsium, by M. Henri **Moissan.** The hydrides of these metals were obtained by heating the metal in hydrogen at about 300° C., the general method adopted being that described in a previous note on the preparation of the hydrides of potassium and sodium. In both cases crystalline compounds possessing the composition RbH and CsH were obtained. These are energetic reducing agents decomposing water, hydrogen sulphide and hydrochloric acid at the ordinary temperature. With sulphur dioxide at low temperatures, and under reduced pressure, hydrosulphites are obtained; carbon dioxide is added on directly with the formation of formates, and amides are produced by the reaction with ammonia.—On the non-conductivity of the metallic hydrides, by M. Henri **Moissan.** An attempt to measure the electric conductivity of the hydrides of sodium, potassium, cæsium and rubidium showed that all these substances act as insulators. These experiments lead to the conclusion that hydrogen is not comparable to the metals, since the metallic hydrides have neither the properties nor the appearance of metallic alloys.—On the motion of vitreous media, affected by viscosity and very slightly deformed, by M. P. **Duhem.**—M. Th. Schlœsing, jun., was elected a member of the section of rural economy in the place of the late M. Dehérain.—The comet 1902 *b*, by M. A. **Senonque.** The results of photographic observations at the Observatory of Meudon. The comparison of the photographs taken on October 6 and 7 shows large variations in the size of the tail of the comet.—On a transformation of a particular class of triple orthogonal systems, by M. C. **Guichard.** On the deformation of surfaces, by M. W. de **Tannenberg.**—On the hypohermitian, by M. Léon **Autonne.**—The rigidity of liquids, by M. G. de **Metz.** From the equation given by Maxwell connecting the viscosity coefficient, the modulus of rigidity, and the time of relaxation of the elastic force, and from some measurements of the rate of relaxation of accidental double refraction in

copal varnish, the author has been able to determine the modulus of rigidity in this liquid, 0·12 absolute unit at 22°·2 C. It is interesting to note that this figure is of the same order of magnitude as the value found by M. Schwedoff for the modulus of rigidity of a half per cent. solution of gelatine, by an entirely different method.—New magnetic systems for the study of very feeble fields, by MM. V. **Cremieu** and H. **Pender.** The disadvantages attending the use of astatic systems for the exploration of very weak magnetic fields are fully discussed, and a new arrangement is proposed consisting of a horizontal arm suspended at its centre by a long wire, and carrying at one end a vertical magnet and at the other a non-magnetic counterpoise. It is claimed for this arrangement that it is extremely sensitive, easily regulated, and capable of being rendered perfectly astatic.—On electric convection, by M. **Vasilesco-Karpen.** Experiments are described by the author which appear to prove beyond question the reality of the existence of the Rowland effect.—A method of stereoscopic radioscopy, by M. Th. **Guilloz.** It is shown that the use of two sources of the X-rays is unnecessary for stereoscopic radioscopy, and that the same effects can be practically realised by the displacement of a single tube.—On a thermostat with electrical heating and regulation, by MM. C. **Marie** and R. **Marquis.** The expansion of acetone or other suitable liquid actuates a relay, by which the heating current is governed. The bath can be kept at any desired temperature within two or three hundredths of a degree.—On cuprous sulphate, by M. A. **Joannis.** The author has succeeded in isolating and analysing the compound of cuprous sulphate and carbon monoxide the existence of which was indicated in a previous note. Its composition is $Cu_2SO_4,2CO,H_2O$; the carbon monoxide is given off in a vacuum, the residual cuprous sulphate decomposing into copper and cupric sulphate, although there are indications that the cuprous sulphate can exist undecomposed in the presence of ammonia.—On some derivatives of oxynaphthoic acid, by M. F. **Bodroux.**—On the nervous system of the Nautilus, by M. Ch. **Gravier.**—On a new mode of constitution of the chain in a new Salpa from the Persian Gulf, by MM. Jules **Bonnier** and Charles **Pérez.** A new subgenus is proposed, Stephanosalpa, and the new species collected at Kumzar is described under the name of *Stephanosalpa polyzona*.—On the influence of the subject on the graft, by M. Leclerc **du Sablon.** The results of a series of experiments on the grafting of different varieties of pears.—On the development of *Cicer arietinum* after section of the embryo, by M. P. **Ledoux.**—On the new genus Protascus, by M. P. A. **Dangeard.**—The formation of antherozoids in *Marchantia polymorpha*, by M. S. **Ikeno.**—On the existence of several successive orogenic movements in the Northern Urals, by MM. L. **Duparc,** L. **Mrazec** and F. **Pearce.**—On the oxydases of cuttle fishes, by M. C. **Gessard.** A study of the ink-producing gland of the cuttle fish shows that, as is the case in plants, the tyrosinase is always accompanied by a laccase.—On the presence of an erepsin in some Basidiomycetes, by MM. C. **Delezenne** and H. **Mouton.**—On the dust deposits of February 22, 1903, by M. F. A. **Forel.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 19.

ROYAL SOCIETY, at 4.30.—On the Formation of Barrier Reefs and of the Different Types of Atolls: Prof. A. Agassiz, For. Mem. R.S.—On Central American Earthquakes particularly the Earthquake of 1838: Admiral Sir John Dalrymple Hay, Bart, F.R.S.—The Emanations of Radium: Sir William Crookes, F.R.S.

LINNEAN SOCIETY, at 8.—On *Poa laxa* and *Poa stricta*, of our British Floras: G. Claridge Druce.—The Botany of the Ceylon Patanas. Part II. Anatomy of the Leaves: John Parkin and H. H. W. Pearson.

FRIDAY, MARCH 20

ROYAL INSTITUTION, at 9.—The Paths of Volition: Prof. E. A. Schäfer, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Prevention of Diphtheria Outbreaks in Hospitals for Children: Dr. Louis Parkes.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—A Premium System applied to Engineering Workshops: James Rowan.

SATURDAY, MARCH 21.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY, MARCH 23

SOCIETY OF ARTS, at 8.—Hertzian Wave Telegraphy in Theory and Practice: Prof. J. A. Fleming, F.R.S.

TUESDAY, MARCH 24.

ROYAL INSTITUTION, at 5.—Great Problems in Astronomy: Sir Robert Ball, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Protection Works of the Kaiser-i-Hind Bridge over the River Sutlej, near Ferozepur: A. Morse

MINERALOGICAL SOCIETY, at 8.—On the Diathermancy of Antimonite: Dr. A. Hutchinson.—A Peculiar Form of Magnetite in Bunter Sandstone: J.B. Scrivenor.—(1) A Large Crystal of a Sulpharsenite of Lead from the Binnenthal; (2) A Twin of Copper Pyrites: Prof. Lewis.—A New Sulpharsenite of Lead from the Binnenthal: R. H. Solly.

WEDNESDAY, MARCH 25.

SOCIETY OF ARTS, at 8.—Oil Light by Incandescence: Arthur Kitson.

GEOLOGICAL SOCIETY, at 8.—(1) On a New Species of Solenopsis from the Pendleside Series of Hodder Place, Stonyhurst; (2) Note on Some Dictyonema-like Organisms from the Pendleside Series of Pendle Hill and Poolvash: Dr. Wheelton Hind.—The Geology of the Tintagel and Davidstow District (Northern Cornwall): John Parkinson.

THURSDAY, MARCH 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Some Physical Properties of Nickel Carbonyl.—Prof. J. Dewar, F.R.S., and H. O. Jones.—The Electrical Conductivity imparted to a Vacuum by Hot Conductors: O. W. Richardson.—An Attempt to Estimate the Relative Amounts of Krypton and of Xenon in Atmospheric Air: Sir William Ramsay, K.C.B., F.R.S.—On a New Series of Lines in the Spectrum of Magnesium: A. Fowler.—An Inquiry into the Variation of Angles Observed in Crystals, especially of Potassium-Alum and Ammonium-Alum: Prof. H. A. Miers, F.R.S.—On the Dependence of the Refractive Index of Gases on Temperature: G. W. Walker.—On the Evolution of the Proboscidea: Dr. C. W. Andrews.

FRIDAY, MARCH 27.

ROYAL INSTITUTION, at 9.—The Pearl Fisheries of Ceylon: Prof. W. A. Herdman, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Advantages of Motor Driven Printing Machines: J. G. V. D. Morgan.

CONTENTS.

THURSDAY, MARCH 26, 1903.

ANCIENT ASTRONOMY.

Sphaera; neue griechische Texte und Untersuchungen zur Geschichte der Sternbilder. Von Franz Boll. Pp. xii + 564; with illustrations and 6 plates. (Leipzig: Teubner, 1903.) Price 24 marks.

THIS is undoubtedly one of the most important works on the history of astronomy that has appeared for many years. The author here publishes and annotates the text of several newly discovered manuscripts of astronomical-astrological authors of the Classical and Byzantine periods. The names of Teukros the Babylonian, Antiochos, Valens, and the poet Johannes Kamateros were known to us before, but Herr Boll has considerably increased our knowledge of them and their work, and he has, indeed, almost added a new chapter to the history of astronomy.

The first part of Herr Boll's work deals with the critical discussion of the new texts, the second with the description of the constellations mentioned in them, the third with the history of the "Sphaera Barbarica" in reference to the work of Nigidius and others. The third part closes with a sketch of the history of mediæval and modern astronomy. To the appendix Herr Karl Dyroff has contributed a most useful edition and translation of part of the "Book of the Great Introduction" (*Kitâb al-mudhal al-kabîr*) of the Arab astronomer of Irak, Abu Ma'sar Ja'far ibn Muhammad al-Balhî.

Naturally the greater part of the book is taken up with a description of the constellations of the Greek and Egyptian Heavens as given by Teukros and the rest. This leads Herr Boll to deal with many extremely interesting questions in the course of his annotations on the words of his authorities. The section on the Egyptian "Sphaera" is extremely good, and we must congratulate a "nichtagyptolog" upon the general accuracy of his critiques of Egyptological and other theories of Egyptian astronomy. Nevertheless, a few references ought to have been made by the author to other authorities besides those who have written in German and French. He seems unacquainted, as far as we can see, with works in English which deal with the subject. Yet there are several of weight and authority, notably Sir Norman Lockyer's "Dawn of Astronomy."

New light is thrown by this author on the question of the origin of the representations on the Græco-Egyptian zodiacs at Dendera and Esna. He shows that the Egyptian element in them is really greater than has often been supposed, and at the same time notes the probable origin of the non-Egyptian constellation-figures, &c., of which the majority are, as in the case with the Greek "Sphæra," of Babylonian origin, such as the Goat-Fish, the Scorpion, the Centaur, &c. The signs of the zodiac are all of Babylonian origin, as Jensen showed several years ago in his useful book, "Die Kosmologie der Babylonier."

Herr Boll further shows that the purely Egyptian figures in these zodiacs and in more ancient astronomical representations in the tombs of the Bibân al-Mulûk and elsewhere are really intended to represent constellations, and not single stars, as Letronne and Ideler thought. He gives interesting parallel plates of the Zodiac of Dendera from a photograph of a cast and from the old picture in the "Expédition de l'Égypte," which is by no means incorrect, as may be seen on comparison with the photograph. Further, on p. 201, he gives an illustration of a circular zodiac or planisphere from a Babylonian boundary-stone of about 1100 B.C.; an important monument in the history of astronomy.

How the Egyptians regarded the stars is shown by the author with the aid of a quotation from Prof. Maspero's "Revue de l'Histoire des Religions":—

"Die ägyptische Anschauung sah überhaupt in den Sternen Leuchten. 'Les astres ne sont pas pour les Égyptiens des corps célestes; ce sont des lampes (khabisou) allumés au firmament. Les Égyptiens concevaient les dieux-étoiles comme certains pères de l'Église considéraient les anges chargés d'entretenir les astres: c'étaient des dieux lampadophores. Au Tombeau de Séti I^er^ Isis-Sothis porte sa lampe sous forme d'étoile à cinq branches au-dessus de sa coiffure et Osiris-Orion la sienne au-dessus de son sceptre.' Ganz besonders aber war nach Brugsch der Name Lampe oder Leuchten (χebs, lucerna) den Dekansternen eigen. Auf den beiden Tierkreisen von Esne sind tierisch-menschliche Gestalten mit Sperber- oder Hunds- oder Widder-köpfen zu sehen, die auf vorgestreckten Händen kleine Lampen tragen: 'dieux lampadophores' oder δεκανοὶ μετὰ λαμπάδων, ganz wie sie Teukros beschreibt."

In dealing with the text of the newly discovered authorities and collating them with one another, Herr Boll has often been led to make interesting comparisons and connections. In describing the Ram and the Bull, Antiochos speaks of a constellation called "The Syrian Horse," ὁ Σύριος ἵππος. Valens, in describing the Bull, puts in place of this "the heavenly Osiris," Ὄσιρις ὕπτιος. It is evident, as Herr Boll points out, that ὁ Σύριος ἵππος is a corruption of Ὄσιρις ὕπτιος, the real name of the constellation. As a corruption it is rather a curiosity.

Herr Boll has omitted to note, in speaking of the constellation Typhon (the Great Bear), that this name is purely Greek, and would have been unintelligible to an Egyptian; he uses it as if he thought it were the Egyptian name. The Egyptologists are to blame for this, and we wish they would banish this "Typhon," identifications of Hathor with "Venus," and talk about "Jupiter" Ammon from their works. The Egyptian name for the Great Bear or Plough is the "Thigh of Set," the Ahriman of Egyptian religion, who was identified by the Greeks with their giant Typhaon or Typhon, son of Typhoeus and grandson of Tartaros. Ordinarily the constellation was called "the Thigh," and a very good name it is too, almost as good as our "Plough," and much better than "Charles's Wain" or the "Great Bear." The form is just that of the thigh of an animal.

Altogether this book will be found very interesting by all astronomers who are interested in the past history of their science, and very useful to the Hellenist, the Egyptologist and cuneiform scholar, who will find (with the English exceptions already noted) the latest results of both astronomical and archæological researches bearing upon the subject of the astronomy of the ancients.

Y

A FRENCH WORK ON SYLVICULTURE.

Traité de Sylviculture. Principales Essences Forestières. By Prof. P. Mouillefert. Pp. xii+544. (Paris: Félix Alcan, 1903.) Price 7 francs.

PROF. MOUILLEFERT, who has taught forestry at the French National Agricultural College of Grignon (Drôme) since 1875, is publishing his lecture notes in the form of an elementary manual of forestry. This he considers necessary for agriculturists and others in spite of the fact that there are already works by Boppe and Jolyet, Broillard and other eminent foresters on the subject. The work is to be in four volumes, of which the present is the first, and deals with the chief French forest species, including exotic trees that thrive in France. The second volume will deal with the management of woodlands, the third with their valuation, and the fourth with artificial plantations, the afforestment of waste land and the restoration of inferior woodland.

The objects set forth as the basis of French forestry are: *first,* to obtain from a forest the greatest annual revenue in the most advantageous manner; *secondly,* to secure the natural regeneration of woods by growing species best adapted to the soil and climate; *thirdly,* to improve the soil as much as possible by rational sylviculture.

The first volume begins with some interesting statistics. The area of French woodlands is about 37,000 square miles, 18 per cent. of the total area of the country, while there are about 24,000 square miles of heath, mountain land, swamps and peat-moor, most of which might be planted. Of the actual woodlands, 68 per cent. are in private hands, 11·8 per cent. belong to the State and 20·2 per cent. to départements, communes and public establishments (hospitals, &c.). Private people can clear their woodlands for agriculture on application to Government, except when their maintenance is necessary to prevent landslips in mountainous country, erosion by water-courses, for the protection of sand-dunes, for military defence, or sanitation. About one-third of the woodlands is in plains (0-200 metres above sea-level), one-third in hills (200-500 metres), and the rest in mountai..s. France is subdivided into three climatic districts—the warm district, with Quercus Ilex and maritime pine; the temperate district, with beech, oaks and artificial plantations of *Pinus sylvestris*; and the cold mountainous district, with silver-fir, spruce, larch, mountain and Cembran pines. Although the author omits *Pinus sylvestris* in this district, the tree grows naturally in Savoy, Dauphiny and Provence, as well as in the Cevennes and the Pyrenees.

As regards the management of the forests, nearly half the area is simple coppice, producing little besides firewood and tanning bark, while one-fourth of the area is under coppice-with-standards, yielding oak, ash and other standards, besides the underwood. Only about 9000 square miles are high forest. There is an error in the areas given by the author for the different systems or I would have quoted them. The total production of wood in 1892 was about 21 millions of tons, of which $5\frac{1}{2}$ million tons were timber, the rest firewood. This gives 40 cubic feet per acre as the annual yield; only one-fourth of this is timber, though in the State forests one-third of the average annual yield (41 cubic feet) is timber. In three départements (Aisne, Nièvre, Doubs) the average annual yield of forests exceeds 70 cubic feet per acre, while in the mountain regions (Pyrenées, Hautes Alpes, Basses Alpes) it falls to less than 14 cubic feet.

The total average annual sales of wood, bark and resin amount to 9,470,000*l.*, or about eight shillings per acre, but the value of the hunting, shooting, quarries, pasture and other minor produce is not therein included, the author estimating their value at 6*d.* per acre in State forests and 1*s.* per acre in private forests.

He does not estimate the cost of management, but as natural regeneration is chiefly practised and the wood is sold standing to purchasers, who are frequently debited with the cost of repairs to roads and with cultural operations, which they pay for out of the value of the timber, these charges not being debited in the accounts, the expenditure is chiefly that of supervision only, which Broillard estimates at about 8*d.* per acre. If, therefore, we wish to estimate the net revenue from French forests, we may allow that minor produce pays for maintenance, while the price of the wood is net profit. With this proviso the following statement shows their average capital value and yield.

Nature of woodlands.	Average capital value per acre.	Net revenue per acre.	Rate per cent. on capital.
	£ s. d.	s. d.	
State forests	20 10 0	13 0	
Communal forests ...	14 16 0	9 5	3·15
Private forests ...	12 5 0	7 7	

In some départements, as in Aisne (beech and oak), the average revenue per acre is said to be 1*l.* 13*s.* 4*d.* and the capital value 54*l.* 13*s.*, while some of the silver-fir forests in the Vosges are at least as valuable, though this is not stated by the author.

As regards prices of wood, although the use of coal, and of coal-gas for cooking, is steadily replacing that of firewood in Paris and other large towns, yet the price of firewood (about $1\frac{1}{2}$*d.* per cubic foot in the forest) has remained steady throughout the last century, while that of timber has more than trebled, good standing oak trees being now about 1*s.* 9*d.* per cubic foot without top and lop.

There is a good chapter on the influence of forests on water-supply and climate, and it is shown that forests drain the soil, but keep the upper layer (15-20 centimetres) moist. The great transpiration of forests maintains a prism of cool, moist air above them, 1000 to 1500 metres thick, and this is readily perceived when the forests are passed by balloons, the latter descending in such cases unless ballast is thrown out. As regards the subsoil, it is found that the water-level is 4 or 5 metres deeper in forests than in the open country, although the rainfall is sensibly greater in the former (100 : 77 in the Fôret de Haye, near Nancy). Climate

and soil are discussed in another chapter, but more detail is required regarding the latter.

The chief part of the book (pp. 38-532) describes the forest species, and is done much in the same way as by Mathieu in "La Flore Forestière," with the addition of some sylvicultural details. It differs, however, from the latter by the addition of ninety-two excellent botanical plates, showing the structure of the branches, foliage, flowers, fruit and wood of the principal species.

The exotic species described are few in number, and most of them are without sylvicultural importance, except in Algiers and Corsica, where species of Eucalyptus, *Grevillea robusta* and *Casuarina tennissima* thrive. Of the few exotic broad-leaved trees which thrive in temperate districts, *Liriodendron tulipifera*, the wood of which from America, combining the qualities of lime, alder and poplar, is largely used in France, *Juglans nigra* and *Carya alba* deserve notice. Among conifers, the Douglas fir, Menzies spruce and *Thuya gigantea* may be mentioned, Weymouth pine having been long naturalised, and figuring among the indigenous species.

This is a valuable book, but its value would have been enhanced had there been more sylvicultural detail. The remaining three volumes will be awaited with interest. W. R. FISHER.

THE ART OF ILLUMINATION.

The Art of Illumination. By Louis Bell, Ph.D. Pp. ix + 345; with 127 illustrations. (New York: McGraw Publishing Co., 1902.) Price 2.50 dollars.

WHEN the importance of artificial light and its effect upon our comfort and eyes is considered, it seems impossible that the technique of healthy and satisfactory lighting should have been neglected in the way it has. The fact, however, remains that although there are books in plenty on the various available illuminants and the generation of light from them, yet the true art of illumination has received but scant attention.

Dr. Louis Bell, in attacking this important problem, has done well in devoting the first three chapters of his book to the effect of light and colour on the eye, and the works of Chevreul, Helmholtz and Abney are effectively laid under contribution to provide a firm foundation for the latter part of the work. The effect of faulty and flickering illumination upon the eye, and the damage to the eyesight brought about by excessive and unshaded lights, is dealt with, but it cannot be too strongly insisted upon that we are living in an age of intemperance with regard to artificial light that is likely, after a few generations, to produce serious racial eye trouble. Already we cannot work with comfort by the light that served our fathers, and although a certain advance in quantity of light was an advantage as saving strain upon the eyes, yet there is no doubt that the present tendency to high-power incandescent and arc lights is not only inartistic, but harmful, as the small area from which the light is emitted and the high intensity throw a serious strain upon the eye, and yet the light given has but little diffusive power.

Chapters iv. and v., which deal with combustible illuminants and incandescent mantles, are the least satisfactory in the book, this being partly due to the fact that the conditions of cost here and in America are so different, and largely also to the evident fact that Dr. Bell is more at home with electric than with combustible illuminants.

When one finds it freely stated that "incandescent electric lamps are about equivalent to ordinary gas in cost, with a tremendous hygienic advantage in their favour," it must be remembered that the cost of the gas is 1 to 1.50 dollars per 1000 cubic feet, and that an electrician always overlooks the fact that the hot products of combustion from a gas flame are among the most powerful factors in ordinary ventilation. In Fig. 21, a Siemens regenerative burner is figured as a Wenham, whilst the Wenham is shown at Fig. 22 as a Siemens. Full justice is done to acetylene, but the author shows but little knowledge of the incandescent mantle when he speaks of it in one place as being composed of various blends of the more accessible of the rare earths and in another says it is "well known to consist essentially of the oxides of the so-called metals of the rare earths, chiefly thorium and yttrium." The data given as to the candle-power and life of the mantle also suggest that this part of the subject has not been quite brought up to date.

In the chapter on incandescent mantle lighting for open spaces, no mention is made of such high-candle-power units as are now given by the high-pressure gas systems and the Kitson (oil) burners; indeed, a mantle giving 100 candle-power is spoken of as somewhat exceptional, whilst in Berlin at the present time there are plenty of mantles giving 1500 candle-power with gas at a water pressure of $4\frac{1}{2}$ feet.

Passing on to the chapters on electric lighting, one has nothing but praise; the author knows his work thoroughly, and a better popular treatise on the subject would be hard to find, whilst undoubtedly the best portion of the whole book is that dealing with the title matter—the art of illumination.

At the present time everything is being done that can be done to increase the intensity of local centres of light, a condition of things brought about by the advent of the electric arc for outdoor illumination, and the feeling that if gas or other illuminants are to hold their own for this purpose, they must be able to complete in this respect.

This, however, is an advance on totally wrong lines, and the author has done good service to the art of illumination by pointing out that its progress must always be in more and more complete subdivision of the illuminating radiants, and the subordination of great brilliancy to perfect distribution.

The concluding chapter deals with standards of light, and gives full credit to Mr. Vernon Harcourt's 10-candle pentane lamp as a trustworthy and reproducible standard.

Everyone interested in the present phases of street illumination will read with pleasure the remarks made by the author on the nominal rating of the candle-power of electric arc lamps, which "have long since

been relegated to the category of merely commercial designations, the rating bearing no more precise relation to the real thing than does the term 'best' as applied to flour or other commodities," a description fully realised when one sees a nominal 1000 candle-power arc blinking with a feeble 200 candle-power duty.

The book is so good, and deals with such a little studied subject, that it is to be hoped that the author will add to the value of the work in its next edition by either giving full references to the original papers or adding a short bibliography. It is undoubtedly a book which should take its place as a work of reference in the library of everyone interested in artificial illumination.

PHYSIOLOGICAL HISTOLOGY.

Methods and Theory of Physiological Histology. By Gustav Mann, M.D., C.M., D.Sc. Pp. xv + 488. (Oxford: Clarendon Press, 1902.) Price 15*s.* net.

A FIRST attempt at scientific research in a new field should always command our respect, and this book, professing to expound the methods of physiological histology with their underlying reasons, is no exception to the rule. The author has with incredible labour collected all the current information on physical chemistry colloids, histology and the chemistry of dye-stuffs, and has endeavoured to combine these into one harmonious and coherent whole, and to deduce from them reasonable answers to all the questions that have arisen on the subjects of the fixation and staining of animal tissues. That the explanations of the observed facts in histology have so far been fragmentary, incomplete and unsatisfactory, no one will deny, and if this work has hardly as yet brought us to a final and definite conclusion, the fault must be laid to the door of our collective ignorance of the matters involved rather than to the writer of the present volume.

A considerable space has been allotted to subjects which bear more or less directly on the theories afterwards propounded, and, as a rule, these are admirable summaries of the work already done. The chapter on colloids is especially worthy of praise. The chapters containing the accounts of the author's own carefully performed experiments are also very interesting, though whether all his readers will or will not agree with his conclusions is quite another matter. However, there is no question as to the success of the fixing fluids which have been proposed as a result of these researches, and the practical directions accompanying them will be of value to everyone who is not familiar with the processes employed. This comment applies also to all the methods recommended for staining, which give the result of a long and thorough experience in the various processes, and, speaking generally, we know of no better practical guide than is to be found here.

Then follow pages—very many pages—devoted to microchemical reactions, the theory of staining, and, as an appendix one-third as large as the book, on the chemistry of the coal-tar colours and similar matters, which space will not permit us to refer to at length. They will well merit careful study, but the question obtrudes itself as to whether the author has not gone a little too far afield, and whether it is really necessary to cover so many pages with chemical details already well known to experts and unintelligible to the ordinary reader without their context.

We regret that the author's modesty has not permitted him to add some account of *intra-vitam* staining and the examination of fresh tissues; we trust that in the future he may see his way to do so.

There are singularly few details to which exception can be taken, and small errors and misprints are conspicuously absent. The paper and general appearance of the book are, however, surely too meagre for the importance of the contents, and drawings of the author's preparations would be vastly more interesting than the illustrations of obsolete microtomes with which we are favoured. One page—460—must have been composed during a nightmare; we cannot imagine it represents the author's real views. It purports to treat of electrical measures. The *ampere* is defined as "a current which passes in every second at the rate of one coulomb through a conductor"! Ohm's law has a whole line to itself, and is thus printed:—"Ohm's law =

$$\text{current} \frac{\text{electromotive force}}{\text{resistance}} = \text{ampere} \frac{\text{volt}}{\text{ohm}} \text{"!!!}$$

It is very kind to tell us what a "macrocallory" is; we might otherwise have supposed it to be a kind of eel; in neither case is it a unit of electricity. Also——but we decently conceal the rest.

There is a very good index, and as a whole the book is one that is a most valuable contribution to our knowledge of physiological histology.

OUR BOOK SHELF.

The Figures, Facts, and Formulae of Photography. Edited by H. Snowden Ward. Pp. 166. (London: Dawbarn and Ward, Ltd., 1903.) Price 1*s.* net.

THERE is probably no other art that is so encumbered with formulæ as photography. Every maker of sensitive material seems to consider it his duty to supply his own particular formulæ for its use, and no doubt this has something to recommend it, but even conveniences may be multiplied until they result in confusion. Many formulæ for developers, for example, differ only in the methods of expressing them, except to an inappreciably small extent due to the use of different weights and measures. And when it is borne in mind that by far the greater number of formulæ are not based on a systematic trial of the effects of varying each of its constituents, as all ought to be, the value of even notable differences disappears.

But to eliminate useless formulæ is practically impossible, as it would introduce differences of opinion as well as of fact. We think, therefore, that the compiler of this volume has done quite right in including the "instructions" of the various manufacturers, and we should have preferred that he had gone even further than he has, and given the formulæ recommended by foreign as well as English houses. Of other formulæ for developers, we find those adopted by Messrs. Burroughs Wellcome and Co. for their "tabloid" preparations described as "standard" formulæ, though

why they should be so singled out is not stated. There is a considerable collection of development formulæ in addition to the above, but only one here and there has the name of its author attached. It would have been better if the author's name had been given in every case, with a reference to the source whence the formula was obtained. Various fixing solutions are given, neutral and acid, one including "acetone-sulphite," but alkaline fixing baths are not represented. Among "stain removers," too, weak alkaline solutions do not appear to be mentioned, though they are the best solvents of the coloured oxidation products of developing reagents.

In a few cases the compiler has ventured to state that one or the other formula is "the best," without quoting any authority or giving any reason for the preference. Among "hypo. eliminators," for example, "the best is plain water," but potassium percarbonate "is the best chemical destroyer of hypo." A soluble hypochlorite was the first "hypo. eliminator" suggested, now many years ago, and it remains unsurpassed, if equalled. It is, however, not mentioned here, and its omission is not due to the ease with which, if carelessly used, it attacks the silver image itself, because sodium hypochlorite is given as a stain remover.

Each of the thirty-three chapters is on a different subject, ranging from "The Studio" and "The Workroom," and the various operations that are generally understood as practical photography, to the "Facts of Copyright" and "Toilet and Hygiene." This last section treats of stained finger-nails; eyes affected by the coloured light of the dark room; skin irritation caused by developers, potassium bichromate, &c.; and similar subjects. The volume is full of information, and cannot fail to prove useful to the photographer who keeps it at hand.

U. S. Department of Agriculture. Field Operations of the Bureau of Soils, 1901. Third Report. Pp. 647 + case containing thirty-one maps. (Washington: Government Printing Office, 1902.)

THE book under notice constitutes the third of the series of reports on the work of the Division of Soils, which is engaged in mapping the distribution and describing the agricultural characteristics of the various soil types met with in selected areas of the United States. The general scope of this remarkable undertaking has already been discussed in these columns when reviewing the Report of 1900 (NATURE, November 6, 1902); the present volume shows that the work of the Division has so far been appreciated by Congress that its progress has been assisted by increased appropriations, enabling it to enlarge its working staff and cover a greater area in its annual survey. The reports now presented deal with the most diversified types of land, and speak of the variety in the conditions under which farming is carried out in the United States. On the one hand, we read of intensive systems of agriculture, analogous to our own, as in New Jersey and Pennsylvania, old settled districts in touch with large centres of population, farming high, and either purchasing fertilisers or keeping stock to make manure; then we pass, as a contrast, to parts of Virginia and Georgia, which were ruined by the war and left without capital or energy, where it is still the custom to crop out the soil by continuously growing corn or wheat, and then clear a fresh farm, leaving the old land to fall back to scrub until it accumulates sufficient decayed vegetable matter to be worth breaking up again.

In the western States the contrasts are just as great between the arid regions, which are still "dry farmed," and can only produce a crop of barley or wheat every other season, the land being fallowed in the intervening years to gather two years' rainfall for the needs of one crop, and the rich irrigated land of California, famous for oranges, apricots, and other valuable fruits.

Two of the most interesting crops which come in for notice in this book are tobacco and sugar beet; in both cases the industry is being very rapidly developed in the United States; indeed, the production of beet sugar is an affair of the last two or three years only, and the expansion has been largely brought about by the energy and advice of the Division of Soils. Anyone seeking a striking example of the way a State can utilise scientific research for the fostering of a national industry cannot do better than study the work on tobacco of the United States Department of Agriculture.

Interesting as these volumes are to the agriculturist from the variety of the crops and the farming conditions described, they are equally valuable to many students of pure science; to the botanist they form a treatise on what might be called applied ecology, to the chemist and physicist the "alkali land" problems will appeal; the geographer will find illustrations, often accompanied by excellent photographs, of the most varied types of land surface and the changes to which they are subject; while the economist, as noted above, may obtain abundant material for his special study. An accompanying report sets the whole cost of the Division of Soils as a little under 8000*l*. for the year 1901; of this, the Soil Survey, exclusive of laboratory work, required a little less than half, 3·53 dollars per square mile for the 5596 square miles covered in the year, or almost exactly a farthing per acre, not an excessive charge on the capital value of the land! A. D. H.

Theoretical Organic Chemistry. By J. B. Cohen, Ph.D. Pp. xv + 578. (London: Macmillan and Co., Ltd., 1902.) Price 6*s*.

THE author commences his preface with an apology for bringing out a new book on organic chemistry. We are not, however, prepared to agree with Dr. Cohen that an apology is necessary. There are not very many good and complete text-books on organic chemistry in this country, therefore a new book—provided that it is good—would not be at all out of place. At another place in his preface the author says, "The production and uses of common materials, which come under our daily observation, are frequently relegated in some text-books of organic chemistry to a background of small print; in others entirely omitted." Dr. Cohen particularises such substances as lanoline, linseed oil, gelatine, the tannins, turpentine, &c. Our interest is at once aroused and we turn up turpentine, and this is what we find:

"Turpentine oil is used as a solvent in the preparation of varnishes, for mixing with pigments, as an embrocation, &c. It absorbs oxygen, when heated in presence of water, and the oxygenated water is employed as a disinfectant and deodoriser."

There is very little here about the production of turpentine. We then turn to linseed oil; here we are more fortunate, because there are seventeen lines devoted to telling us that the oil may be used for preparing linoleum, oil-cloth, and that it is employed in making varnishes and paints—but not a word as to its production. Again, the treatment of gelatine, tannin and lanoline can scarcely be called exhaustive. We are not at all sure that it is desirable in a text-book, the size of the one before us, to describe such substances in detail, but when the author lays claim to treat them more fully than they are treated in other text-books, one is rather surprised to find them dismissed with such scanty notices.

Of course, details of this kind do not condemn a book, and, in many respects, the book is very good.

We have read some of the chapters with considerable interest and pleasure, notably those which deal with the phenols and with the carbohydrates, the subjects of which are carefully and fully dealt with. In some parts of the book, however, the explanations are not so clear as we could have wished, the reactions being given with little or no attempt at an explanation. Now the average student requires a considerable amount of explanation in order that he may understand the subject. As an example of want of clearness we think it would have been wise to give some explanation of the probable mechanism of the process involved in the preparation of benzaldehyde by the action of metallic nitrates on benzyl chloride, and some explanation of Reimer's reaction would not have been out of place.

The book is well printed, and the proofs have evidently been very carefully corrected. Taken as a whole, we consider Dr. Cohen's book a very useful compilation; from the preface we had expected to find a book written on new and original lines; in this, however, we were disappointed. F. M. P.

Nature Studies (Plant Life). By G. F. Scott Elliot. Pp. viii + 352. (London: Blackie and Son, Ltd., 1903.) Price 3*s.* 6*d.*

It is not evident whether the author intends this book as a contribution to the subject of "nature-study," which is now attracting so much attention. Certainly the first and most essential feature of nature-study, namely, personal observation, is not emphasised, nor is the discursive style which the author adopts calculated to induce careful and accurate investigation. A large mass of information has been brought together, compiled from books on bionomics and original papers. The book begins with the flower and fruit, and the vegetative portions follow, an arrangement which has its advantages since morphology is sacrificed to bionomics. The relations between animals and plants are well brought out, but less prominently so the relations between plants *inter se.* The study of plant associations begins with the Cryptogams, and here, as indeed in most of the chapters, the matter is too fragmentary; only occasionally, as, for instance, in the chapters on seaweeds, or when describing the lichens, does Mr. Scott Elliot take the necessary space to do justice to himself and his subject. The concluding chapters dealing with the origin and development of the English flora introduce a subject which is well worth studying.

Das Objectiv im Dienste der Photographie. By Dr. E. Holm. Pp. xvi + 142. (Berlin: Gustav Schmidt, 1902.) Price 2 marks.

Those photographers, whether professional or amateur, who are able to read German will find this book full of useful information and valuable hints regarding the properties and use of the photographic objective. So numerous, so varied in construction, and so different in price are lenses of to-day that it is important that the photographer should know something of their nature and capabilities before investing in one or more of them. The present book is intended to give the reader a good all-round idea of not only the properties of lenses, their errors, corrections, the different kinds available, and hints on choosing them, but also how to use them when obtained. Although the text quite fulfils this object, the very excellent set of reproductions illustrating all the kinds of results which accrue from good or bad focusing, setting, choice of position, &c., adds greatly to its value, and demonstrates better than any words could do the points to be observed. The telephotographic lens is also included in these pages, and the book concludes with quite a full index.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Permanent Electric Vibrations.

In his "Electric Waves" (see p. 361) Mr. Macdonald considers that electric waves may be propagated round a ring without being subject to any loss by radiation. The question whether this is possible is of great interest, as such waves might play an important part in atomic phenomena. It seems, however, that such waves cannot exist, except possibly in exceptional cases. For consider a spherical surface to be drawn enclosing the whole of the vibrating system. The electric force cannot vanish at all points of this surface, for the sphere may be as close to the conductors as we please. From the value of the force, and the condition that at infinity any motion that there may be must consist of outwardly progressing waves, we can find by spherical harmonic analysis the field at any point outside the sphere. The result is that in any case the field cannot at all distant points be of an order lower than that of $1/r$; there must be loss of energy by radiation. For a thin circular wire a fundamental mode of vibration is determined, to a first approximation at least, in *Proc. Camb. Phil. Soc.*, vol. ix. p. 326; and the case of a wave progressing round the wire can be deduced by compounding two such vibrations differing in phase. The determination of the resultant disturbance at a great distance involves Bessel's functions in general, but it can be proved without difficulty that for points on or near to the axis of the ring it consists of divergent waves. The consequent rate of loss of energy is of the order of unity, while the energy held is of the order of $\log(a/\epsilon)$, where ϵ is the radius of the wire and a that of the circle. The decrement is hence of the order of $1/\log(a/\epsilon)$, as found in the paper referred to.

On the other hand, it is hard to find a flaw in Mr. Macdonald's general reason for the absence of radiation in this case, and the possibility of non-radiating systems is suggested by the case of a uniformly and superficially charged dielectric sphere of unit specific inductive capacity. If it performs small simply periodic oscillations, each point of its surface may be treated as a Hertzian oscillator. On evaluating the external field, we find that the variable part of it is the same as if the charge were collected at the centre and multiplied by $(\sin \lambda a)/\lambda a$, where a is the radius of the sphere, and $2\pi/\lambda$ is the wave-length in free ether corresponding to the frequency of the oscillation. Hence, if this wave-length is a submultiple of the diameter of the sphere, there is no external oscillating field.

H. C. Pocklington.

The Bearing of Recent Discoveries on the Physics of Taste and Smell.

One of the first experimental papers on the nature of the stimulus given to the organs of taste or smell by sapid or odorous substances is, I think, that by the Hon. R. Boyle ("Experiments and Observations about the Mechanical Production of Tasts (*sic*)," London, 1675), in which he puts forward a theory of irritation by particles which penetrate and irritate more or less according to their size and shape. After this a chemical theory of taste seemed to gain ground, and Graham laid down the principle that only soluble substances are sapid, and that further only crystalloid solutes are sapid (see Bain, "Senses and Intellect," 1864). Then in 1882 Sir W. Ramsay very tentatively put forward a dynamical theory from analogy with optics and sound (Nature, xxvi. 187). He proposed that very light molecules vibrating at a high rate are inodorous, taking as the limit a molecular weight of about 30. On the other hand very heavy molecules would be odourless, because vibrating too slowly, whereas those vibrating at a rate between these limits would find the nerve-cells capable of response. Thus he accounted for the want of odour on the part of H, CH_4, O, N, H_2O, &c. Similar views were later ex-

pressed for taste and smell by Haycraft (*Proc.* Roy. Soc. Edin., 1883–1887).

But we now know gaseous bodies ranging over the whole domain of molecular weights appropriated by odorous and sapid substances, owing to Ramsay's well-known work on He, Ne, A, Kr and X, and to the discovery of SO_2F_2 and SF_6 by Moissan (*Comptes rendus*, cxxx. 1900, 865 and cxxxii. 1901, 374). These last two gases are of special importance because their want of taste and odour cannot be due to the fact that we have become inured to them. The molecular weights of these bodies are respectively 4, 20, 40, 81, 127, 102 and 146, with which may be compared vanillin, with a molecular weight of 152.

It was long ago pointed out by Liebig (see Klimont, "Die Synthetischen und Isolirten Aromatica," 1899) and by Graham (see Bain, *loc. cit.*) that odorous bodies are, as a rule, readily oxidised, and the notion of the chemical origin of the senses in question is much strengthened by the fact that all the new gases above mentioned are very inert. SO_2F_2, although soluble in ten parts of water, can only be decomposed by oxygen by sparking, and SF_6 is extraordinarily stable. It is recorded also by Graham that if an odoriferous principle is sniffed up in a current of CO_2 instead of air, the odour is much weakened.

There is another curious fact which might be accounted for by a chemical hypothesis. It has often been noticed that on purifying odorous or sapid substances, these properties tend to become less marked or to disappear. Thus acetylene, ammonia and acetamide have been described as odourless when pure, and it is said that ordinary sugar becomes less sweet the more it is purified. But it has been found in all carefully studied cases that stability increases very markedly with purity, and therefore on a chemical theory taste and smell would become correspondingly less.

In conclusion must be noted Prof. Ayrton's important contribution to this subject (Presid. Address to Section A. British Association, 1898), in which he definitely proves that the well-known metallic odours are not caused by the metals themselves (which are non-volatile), but by unstable decomposition products, probably unsaturated hydrocarbons.

Such a chemical explanation would not, of course, upset the vibration theory of Ramsay, but would merely mean that instead of these senses being directly stimulated by the ordinary vibrations of the molecules, they are only affected by agitations accompanying chemical change.

F. SOUTHERDEN.

Technical College, Finsbury, London, E.C., March 21.

Electricity and Matter.

IN view of the suggestive close of Sir Oliver Lodge's paper as given in NATURE of March 12, these more than century-old speculations of S. T. Coleridge may be found interesting.

E. H.

"But properties are God: the naked mass
(If mass there be, fantastic guess or ghost)
Acts only by its inactivity.
Here we pause humbly. Others boldlier think
That as one body seems the aggregate
Of atoms numberless, each organized;
So by a strange and dim similitude
Infinite myriads of self-conscious minds
Are one all-conscious Spirit, which informs
With absolute ubiquity of thought
(His one eternal self-affirming act!)
All his involved Monads, that yet seem
With various province and apt agency
Each to pursue its own self-centring end.'

(From "The Destiny of Nations—A Vision," Juvenile Poems, S. T. Coleridge.)

Papaw-Trees and Mosquitoes.

Re Prof. Percy Groom's letter in NATURE (January 22, p. 271), I may mention that in Ceylon the papaw-tree gives no immunity against mosquitoes. In my garden here we usually take our afternoon tea under the shade of an old and much-branched example of the common papaw (*Carica papaia*), but far from being protected from mosquito bites in that situation, we are always terribly molested by the small striped mosquito (*Stegomyia scutellaris*). The stem of this tree is also haunted by various spiders and flies. I have not sufficiently studied the tree during the sunny part of the day to say whether flies settle on the leaves or not, but I propose to pay attention to this question shortly.

E. ERNEST GREEN.

Royal Botanic Gardens, Peradeniya, Ceylon, February 26.

A Remarkable Meteor.

WITH reference to the meteor a letter of mine concerning which you printed in your last issue (p. 464), I have received some details from Mr. G. S. Russell, of West Norwood, who saw it from the neighbourhood of the Crystal Palace. From the facts that he saw it E.N.E. (as I did) and saw the "wobbling" close to earth, it is seen that the meteor must have been a great distance off, probably falling a considerable distance out in the North Sea. He is convinced that it reached the earth's surface. Its great distance off would account for its apparently very slow movement. Owing to the steadiness of both its brilliancy and velocity it was probably of great size.

J. E. C. LIDDLE.

Fairfields, Basingstoke, Hants, March 23.

THE MOVEMENT OF AIR STUDIED BY CHRONOPHOTOGRAPHY.

THE investigation of stream lines has occupied the minds of several powerful workers, and great results have been obtained by the late W. Froude and Prof. O. Reynolds, and recently Prof. Hele Shaw has added some striking illustrations of the paths of the flow of liquids. Borda, in an almost forgotten, but remarkable paper (*Memoires de l'Académie Royal*, 1766), writes thus (when describing the conditions under which water flows by an opposing object):—"On imagine ensuit que les molécules du fluid, en s'approchant du corps, decrivent des lignes courbes, ou plutôt se meuvent dans les *petits canaux courbes.*" Borda goes on to show that theoretically the stream lines should flow round and again join in the rear of the object.

Thus the idea of stream lines and their behaviour was regarded as a matter of interest at an early date.

In a recent paper, in the *Bulletin des Séances de la Société Français de Physique*, 1902, M. Marey has added fresh information respecting the form of stream-lines, and by his new experimental methods he shows how air behaves as it flows by different shaped objects. In the first place he draws attention to his experiments on the movements of liquids in which he employed a stream of water, holding in suspension shining pearls of the same density as water; these were brightly illuminated by sunlight, a dark background being placed behind them; by means of a chronophotographic apparatus, a series of pictures of the illuminated parts was taken, their appearance in the picture being that of dotted lines. The direction and speed of the current which carried them along was by this means found.

When obstacles of different shapes were placed in the current the stream lines of the liquid were seen to bend in different ways and to form eddies. For example, in the case of water impinging against an inclined plane, the streams of liquid divide at a point, which appears to be the centre of pressure. In each case eddies form in the rear of the obstacle. The speed of the fluid, at any moment, could be recognised on the photograms by the degree of separation of the shining pearls, for photographed as they were, at equal times, they covered different distances in these equal intervals of time. A divided scale gave the lengths of these distances covered, while the rate of taking the successive pictures (ten per second) gave the speed of the current in its various positions.

By means of a method similar to this the direction and speed of the streams which form in a current of

air were studied, and the changes which they underwent when they encountered obstacles.

The apparatus for investigating these movements in air was of simple character; it consisted of a chimney of prismatic form (side 0·50 m., height 0·75 m.). The front side was made of clear glass, and the posterior wall was covered with black velvet; the left wall was white and the right one was glazed.

In front of the apparatus a lantern was placed within which a magnesium flash could be fired. A draught was maintained through the chamber by an electric fan. The flow of air was rendered steady by being filtered through silk gauze of fine mesh, placed at the top and at the bottom of the prismatic chamber. By a beautiful method M. Marey rendered the direction of currents of air visible; he introduced minute streams of smoke, which were drawn in with the aspirated air, and remained parallel to each other during their passage through the chamber when not opposed by any obstacle. The smoke was obtained from the combustion of tinder and cotton in a closed furnace; from this furnace the smoke was conducted to a series of narrow tubes parallel to one another.

When an obstacle was placed within the chamber the stream lines were seen to bend against the obstacle and divide into two currents, one of which flowed up the slope of the inclined plane, the other down it (Fig. 1). The division appeared to take place at a point which corresponded with the centre of pressure against the inclined plane. This point of separation was found to be at the middle point of the plane when the plane was horizontal, and to approach its upper end the more the plane was inclined. Behind the obstacle eddies were seen to form.

Fig. 1

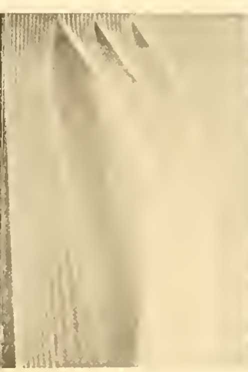


Fig. 2.

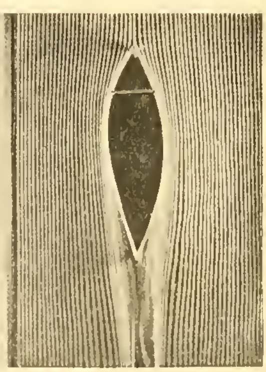


Fig.

M. Marey found the velocity of the air streams, thus. By means of an electric vibrator he imparted vibrations to the smoke jet tubes, having a period of ten per second. The smoke streams then became sinusoidal in shape, the inflections being maintained during the whole length traversed by the smoke. The series of lateral inflections was measured by means of a divided scale placed in the same plane as the streams of smoke.

These inflections remained equidistant when the speed of the current remained constant, but when the speed was reduced the inflections were closer together, and farther apart when the speed of the streams was increased. M. Marey employed the magnesium flash to obtain his photograph; probably sharper pictures would have been obtained by using the electric spark from a charged Leyden jar as an illuminant.[1] M. Marey mentions that an important question to be answered in the science of aërial flight is, How do air currents behave when passing through adjacent parallel planes inclined at an angle to the stream? Fig. 2 answers the question clearly. The picture will suggest much to those engaged in the designing of kites of the *box* type, where the air strikes against more than one plane.

The conditions of stream line flow round different aquatic animals have received considerable attention, and we know that a blunt head and a pointed tail is a favourable arrangement. By immersing solid bodies having one end obtuse and the other pointed, it is observable that there is a great advantage in presenting the large end to the direction of motion; this minimises the motion of the air behind the body. The same phenomenon is to be seen in air. Fig. 3 shows that, with the large end facing the stream, the disturbance in the rear of the object is slight, only small eddies being set up. M. Marey's methods are applicable to an almost endless variety of similar experiments on the stream lines of air round differently shaped bodies. M. Marey's paper is short and condensed, but it contains matter of much importance, and is another example of the beautiful results obtained by this master of experimental methods in chronography.

F. J. J.-S.

[1] Spark photography of objects in rapid movement (smoke jets and smoke rings photographed in collision). Junior Scientific Club, Oxford; NATURE, vol. xlvii. p. 119.

THE VENTILATION OF THE TUBES.

IN October, 1901, the London County Council determined to investigate the condition of the atmosphere in the tube of the Central London Railway, in order to ascertain how far the threatened multiplication of underground tubes might affect the public health. As the result of this, the chemist to the County Council, in conjunction with Dr. Andrewes, made a chemical and bacteriological examination of the condition of the atmosphere in the tunnels, stations, carriages, and lifts of the Central London Railway, as compared with the outside air under ordinary conditions. As might have been expected, it was shown by the experiments that the fluctuations in the amount of carbon dioxide and organic matter present in the tube were very great.

Examination in the early morning showed that the ventilation employed had produced a very fair condition of air, whilst during the hours of traffic the carbon dioxide rose to considerably higher limits than existed in the outer atmosphere. The County Council chemist considers that samples of air taken at any point on the railway should not contain more than double the amount which is found in the air of the streets, inasmuch as the additional carbon dioxide found in the air of the tunnels has been entirely produced by respiration, and is therefore accompanied by organic matter.

This report was submitted to the Council on February 17, but its reception was postponed, as it is clearly one of those cases in which extreme caution should be used in arriving at conclusions, and introducing rules and regulations which might hamper important developments in the relief of our over-congested traffic.

The normal quantity of carbon dioxide present in the air is a little under four volumes in ten thousand, and the sanitary limit, which is universally adopted for the atmosphere in our dwelling-houses, is six parts in ten thousand in rooms which are to be inhabited for any

length of time, this being fixed on the assumption that the organic matter in the air increases at the same ratio as the carbon dioxide, but it is evident that this limit may be exceeded without damage to health when such atmosphere is only to be inhaled for a short period.

On examining the report of the Public Health Committee, it will be noticed that the carbon dioxide was highest in the air of the carriages, and that the air in the lifts also contained a larger quantity of carbon dioxide than the passages leading to them, showing that, as might have been expected, the enclosed areas in which respiration was taking place contained the largest quantity of carbon dioxide.

Before it can be assumed from this that the impurities found are due to want of ventilation in the tube, it should be clearly shown what the comparison is between the carbon dioxide and organic matter present in a carriage on the tube, and a carriage (say) on the North London Railway during the busy hours of traffic, or even in some London theatres towards the close of a performance, and it will probably be found that the difference which exists is very small indeed.

The real hygienic value of the report centres in Dr. Andrewes's summary of his results, in which he concludes that while micro-organisms are present in the tube air in a somewhat greater proportion than in fresh air, *i.e.* 13 to 10, the excess is not so considerable as to cause the tube air to compare unfavourably with the conditions known to exist in inhabited rooms generally. The highest averages of micro-organisms were found in carriages and lifts, *i.e.* in the most crowded places examined, whilst the platforms and passages came out actually better than the fresh air, the tunnels being only a little worse.

If we consider this as well as the fact that the Central London Railway Company is taking steps to improve the ventilation of the tunnels by installing a large rotary fan at the Shepherd's Bush end powerful enough to draw out the whole of the air in the tunnels three times over during the period in which traffic is stopped, and is installing at the Bank station an air compressor for forcing fresh air into the extreme end of the Bank sidings, it seems clear that the facts of the case do not call for any active interference on the part of the authorities, especially after the atmosphere existing in the Metropolitan Railway between (say) King's Cross and Baker Street has been patiently endured for so many years.

THROUGH PERSIA AND BALUCHISTAN.[1]

UNDER a somewhat quaint title, Mr. Landor describes a journey through Persia and Baluchistan to India. He is a keen observer, and, throughout his two large volumes, he writes pleasantly of his experiences on the road, and of much that he saw and heard by the way. He is a little inclined to dwell upon the discomforts rather than upon the pleasures of travelling, and to get excited over "a prominent geographical society," "royal geographo-parasites," and "newspaper penny-a-liners," but he is always amusing. He gives his views with great frankness upon the social condition of Persia, so far as he became acquainted with it, and upon questions of trade, education, and politics. He writes strongly upon the struggle between England and Russia for political and commercial supremacy in the kingdom of the Shah, and gives a clear idea of the smartness with which Russia takes advantage of the slowness and mistakes of her adversary.

Mr. Landor travelled *viâ* Flushing, Warsaw, and Kiev to Baku; crossed the Caspian in a Russian steamer; and, after a sleepless night on a "living" mattress, entered Persian territory at Enzeli. Thence he proceeded to Resht, and drove along the carriage road to Teheran, where he was presented to the Shah, visited several of the Persian Ministers, was present at the birthday festivities, and saw all that is most worth seeing in the capital. An interesting description is given of the Shah's palace and gardens, and, in some remarks on the Persian army, attention is drawn to the great difference between the "Russian-drilled Persian Cossacks" and the infantry soldiers. From Teheran Mr. Landor followed the post road to Isfahan, and thence travelled *viâ* Yezd to Kerman, where he visited the deserted city of Farmidan, and the "Ya Ali" inscription. From Kerman he turned north and crossed the salt desert, Dasht-i-Lut, to Birjand, passing on the way Naiband, of which place and its people many interesting details are given. In the desert he suffered, as others have done in desert countries, from heat and thirst by day, and from cold by night. But he appears to have been more than usually unfortunate in his camels, which do not seem to have been in good condition for a long desert journey, or to have been accustomed to hill work.

FIG. 1.—South-East portion of Zaidan City, showing how it disappears under distant sand accumulations. (From Landor's "Across Coveted Lands.")

From Birjand Mr. Landor followed the well-known route through Sistan and Baluchistan to Quetta. He has much of interest to tell about the ruins of Zaidan, in Sistan, and gives several photographs of one section of them. But surely it is inappropriate to write of the place as "the ancient London of Asia," as if it were of extraordinary size and unusual grandeur. The ruins in themselves are not very imposing, and the view

[1] "Across Coveted Lands." By A. H. Savage Landor. 2 vols. Pp. xv + 927. (London: Macmillan and Co., Ltd., 1902.) Price 30s. net.

of Major Sykes that they represent villages built along the line of an irrigation canal seems more reasonable than the opinion of the author that they are the remains of a city eighty-five miles long. The ruins, however, certainly require careful examination, and such excavation as may determine their character and history.

The concluding chapters give a description of the road from Robat through Nushki to Quetta which has recently been completed with good rest houses supplied with water. It is very pleasant to read Mr. Landor's appreciative remarks on the manner in which the British officers connected with the road carry out their multifarious duties, and on the high esteem in which they are held by the natives amongst whom they live and work.

The general impression on reading the book is that Mr. Landor might have conveyed his message from much-travelled Persia and Baluchistan in a less formidable form than two volumes containing more than 900 pages. Still, the work appears at an opportune time; it gives much information in a popular form, and those who are not acquainted with what has been written about Persia will find in it much to instruct and amuse. The illustrations from photographs and sketches by the author are numerous; nearly all of them are good, and some are excellent. C. W. W.

ABANDONMENT OF THE SCHOOL OF MEDICAL RESEARCH AT NETLEY.

THE extinction of the School of Research in Tropical Diseases in connection with Netley Hospital, and the abandonment of prophylactic inoculation against typhoid fever, the adoption of which has already resulted in a marked saving of life, have been noticed with regret by all men of science acquainted with recent advances in scientific pathology.

Mr. Brodrick's action in placing the Army Medical Service under the Advisory Board, constituted, so far as its predominating civilian element is concerned, of members out of touch and sympathy with medical research, has had a disastrous effect on the future prospects of the development of scientific research in connection with the Service.

Though a large sum has already been spent on the plans for, and the foundations of, the research laboratories at the Royal Victoria Hospital, Netley, and in face of the fact that Parliament had voted 45,000*l.* for the purpose, the research laboratories at Netley are to be abandoned. More than this, clinical study in tropical medicine has been eliminated from the programme of instruction for officers entering the Army Medical Service, and the scientific departments associated with the work of Netley Hospital have been hurriedly transferred to cramped and temporary laboratories in London.

The abandonment of the research laboratories at Netley, and their transfer to limited and temporary quarters in London, must be detrimental to the progress of research in tropical medicine. For, whereas the school at Netley was in connection with the Royal Victoria Hospital, which is by far the largest emporium of tropical diseases in the country, in the case of the London school, sick men must be brought from the healthy surroundings of Netley to the unhealthy town atmosphere of London if their diseases are to be made subjects of scientific study.

The retrograde policy which has thus been inaugurated shows a complete disregard for the value of scientific knowledge in medicine. Of bad omen, too, for the future of science is the placing of the professoriate under the orders of a Military Commandant, and above all the limitation of the tenure of the professorships to the ordinary three years limit as fixed for staff officers. We cannot state the case better than it is put in a letter by Sir James Martin to Sir James Clark when this question was raised and quashed in connection with the Army Medical School in 1863—quashed only to be reopened again, after forty years, in 1903. "There is no comparison, I think, between the nomination of military officers to staff offices and that of scientific men as teachers. The duties of the first-named are ordinary and every-day. The duties of medical officers as teachers of the most difficult of all sciences, including that of climate, are altogether another affair, and to change such teachers at short terms—men of peculiar and acquired excellences and experiences—would go to destroy any scientific institution whatever."

The downward course entered upon has been further signalised by the dismissal of Prof. A. E. Wright, professor of pathology at Netley, on the ground of his acceptance of a post in connection with a metropolitan hospital, a post which competent judges allege would have in no way interfered with his official duties, but might have proved valuable in providing further material for the complete instruction of his classes. But in face of the terrible lessons of the recent war in South Africa, perhaps the most serious result of Mr. Brodrick's action is the proposal to abandon antityphoid inoculation in the Army, and this, too, upon the recommendation of a subcommittee of the advisory board which considered it unnecessary either to give Prof. Wright an opportunity of appearing before it or to make for itself any statistical inquiry.

There is, unfortunately, nothing new in this country in a policy such as that we have outlined. An equally flagrant case of brain starvation is the educational vote included in the Army Estimates, where, as the *Times* points out, in a total military Budget of 34,000,000*l.* only 134,000*l.*, or about 0·4 per cent., are devoted to education. The lessons which have been learnt in other countries, where men of science are systematically consulted upon all questions the solution of which demands scientific knowledge, have led to a marked increase in their national prosperity. The rulers of our Empire will some day understand what immense loss the neglect of science entails, and until this is fully appreciated it is the duty of all who know to explain on every occasion.

As an indication of the value attached by our foremost pathologists to the work upon which Prof. Wright was engaged at Netley, we print below a letter from Dr. E. Klein, which he has given us permission to publish.

In common with many other physiologists and pathologists in this country, I have noticed with extreme regret the omission of Prof. Wright from the teaching staff of the Army Medical Service.

Prof. Wright, by his numerous researches and valuable discoveries of new methods in the study of the physiology and pathology of the blood, by his systematic work on antityphoid inoculations, has won for himself the reputation of an original investigator of the foremost rank. Moreover, by the eminently practical work of his pupils in the Army Medical Service, he has demonstrated the great value of a research laboratory for the Army Medical Service.

Everyone interested in the advancement of medical science in general, and of the teaching of scientific pathology to our Army medical officers in particular, will gladly admit the great services which Prof. Wright has rendered while at Netley. E. KLEIN.

EARTHQUAKE IN THE MIDLANDS.

EARTHQUAKE shocks were felt at many places in the midland counties about 1.30 p.m. on Tuesday. The reports which have been received up to the time of going to press show that the counties of Derby, York, Stafford, Cheshire, Notts and Leicester were affected by the disturbance. Two shocks were felt at most places, one a few minutes after the other. Though no very serious damage was done, the rumbling noise and the vibrations due to the earthquake caused much alarm, and people ran from their houses into the streets. We give below a summary of the reports which have appeared in the daily papers, and the report of an interview with Prof. Milne, published in Wednesday's *Daily Mail.*

DERBYSHIRE.—*Derby.* Shocks felt at 1.10 p.m. Duration, 5–10 seconds. Houses shaken, windows rattled, and crockery overturned. Rumbling noises heard. Second shock at 1.29 less severe.—*Matlock Bath.* Two shocks at about the same time as Derby. Duration, about 45 seconds. Slight rumbling sound.—*Alfreton.* Three shocks. Many buildings shaken and cracked. Chimney overthrown.—*Ashbourne.* Chimney overthrown.—*Buxton and Bakewell.* Pictures and ornaments displaced by vibration of walls of houses, and crockery overthrown.

NOTTINGHAMSHIRE.—*Nottingham.* Time about 1.30 p.m. Duration, 5–6 seconds. Large buildings in centre of city seen to sway.

YORKSHIRE.—*Sheffield.* Slight shocks felt.—*Dore.* Time, 1.30 p.m.–1.40 p.m. Houses shaken, bells rang, windows and crockery rattled.—*Baslow.* Rumblings heard and houses and objects shaken.

STAFFORDSHIRE.—*Burton-on-Trent.* Two shocks felt at 1.30 p.m. Windows violently shaken, and crockery and furniture rocked by prolonged vibrations.—*Stafford.* Time, 1.40 p.m. Two shocks. Vibration of ground felt, and objects overturned.—*Uttoxeter.* Time, 1.32 p.m. Duration, about a minute. Tables and chairs moved several inches. Doors and windows rattled. Bells rang.—*Hanley.* Time, 1.40 p.m. Duration, 30–40 seconds. Tables and chairs rocked, and many objects overthrown.—*Leek.* Time, 1.35 p.m. Rumbling noise heard, followed directly afterwards by vibration. Second shock of greater intensity felt a few seconds later. Shocks also felt at Stoke, Longton and Kidsgrove.

CHESHIRE.—*Northwich.* Time, 1.30 p.m. Decided movement. Objects displaced.—*Comberbach.* Chairs rocked as though heavy traction engine was passing.

EAST LANCASHIRE.—*Blackburn.* Time, 1.15 p.m. Crockery overthrown. Second but less severe shock at 1.35.

Prof. Milne's Views.

"My seismograph photographic films are not yet developed, but they will be to-night, and I shall see whether vibrations of this shock reached as far as the Isle of Wight. It is very doubtful whether they did, because my instruments are not constructed to record the exceedingly rapid vibrations which we get from local shocks.

"The probability is that this earthquake is similar to those which from time to time have had their origin in Leicestershire and the Severn Valley, the last of which was on December 16, 1896. That occurred about 5.30 a.m., and about Hereford did a considerable amount of damage in shattering buildings. In fact, its destructive effect was felt even as far as Birmingham, while people were awakened at Alderley Edge, Manchester, and in towns further north. The vibrations extended eastwards, certainly as far as London.

"This latest earthquake probably means that there has been some adjustment or slight slip on the line of a preexisting fault or fracture in the earth's crust. Careful observation of the times at which this has been felt in different parts of Great Britain will no doubt lead to the determination of the extent of such fault, and thereby help the work of the Geological Survey.

"A very feeble trace of the last Severn earthquake was obtained in the Isle of Wight, but it was difficult to distinguish between what were earthquake and what artificial disturbances. In order to make this distinction in regard to local shocks, it will be necessary for some enthusiast to isolate himself in the centre of a district like Dartmoor, and live the life of a hermit."

NOTES.

THE investigation of the properties of radium salts has led to many remarkable results, among which those contributed by MM. P. Curie and A. Laborde to the current number of the *Comptes rendus* are not the least remarkable. They adduce evidence to show that radium salts give off heat continuously. The experiments were made in two ways. Two small bulbs, one containing 1 gram of a radiferous barium chloride containing about 1/6 of its weight of radium chloride and the other containing a similar weight of ordinary barium chloride, were placed under similar thermal conditions with a junction of a thermocouple in each bulb. The bulb containing the radium preparation proved to be $1^{\circ}.5$ hotter than the other, and this temperature difference was maintained. An independent confirmation was obtained with the Bunsen ice calorimeter. At the moment the radium bulb was introduced, the mercury, which was previously stationary, commenced to move along the tube with a perfectly uniform velocity, and on the bulb being taken out the mercury stopped. From these experiments, which are given as preliminary and only roughly quantitative, the authors conclude that a gram of pure radium would give off a quantity of heat of the order of 100 calories per hour, or 22,500 per gram-atom per hour, a number comparable with the heat of combustion in oxygen of a gram-atom of hydrogen. The disengagement of such a quantity of heat cannot be explained by the assumption of any ordinary chemical transformation, and this excludes the theory of a continuous modification of the atom. The heat evolution can only be explained by supposing that the radium utilises an external energy of unknown nature.

REPORTS of the following volcanic eruptions and earthquakes have appeared since we went to press last week:—*Vienna.* Violent earthquake shocks were experienced during the night of March 19 and early in the morning of March 20 in the Semmering district and the Mürz Valley, in Styria. March 21. *St. Thomas.* Mont Pelée emitting dense clouds. March 22. *St. Thomas.* There was a violent eruption of the St. Vincent Soufrière. Kingstown was covered with a dense black cloud, the sun being completely obscured. Three inches of sand and rock fragments have fallen at Georgetown and Château Belair. *Barbados.* Complete darkness caused by fall of volcanic dust from the Soufrière. *Dominica.* Frequent loud detonations heard to the south-east, and clouds of dust seen to westward. *Kaiserslautern.* At 6 a.m., and again at 2 p.m., violent earthquake shocks were felt almost everywhere in the south of the Bavarian Palatinate from Landau to Wörth. *Cuneo (South Piedmont).* Earthquake shocks felt, but no damage done. March 23. *Grenada.* Eruption of the Soufrière began 6.30 a.m.; immense clouds, comparative absence of lightning a feature; no injury beyond heavy fall of sand and small stones two to three inches at Georgetown; quieted down during afternoon. March 24. Earthquake in the Midland Counties (see adjacent column).

THE West African Company's steamship *Sokoto*, which arrived at Plymouth on March 20, reports having encountered a sandstorm. The report reads as follows:—"The vessel was enveloped for eight days in a sandstorm

off the African coast. So dense was the sand that speed was reduced owing to the impossibility of seeing far ahead, and even at midday passengers had to resort to artificial light for the purposes of reading. The ship was navigated by dead reckoning, it not being possible to secure observations. The storm is described as the worst in an experience embracing twenty-five years."

The annual meeting of the general board of the National Physical Laboratory was held at Bushy House, Teddington, on Friday last. Lord Rayleigh, the chairman of the board, was supported by Sir F. Hopwood, Sir E. Carbutt, Sir W. Preece, Sir A. Rücker, Col. Crompton, Mr. A. Siemens, Prof. Perry, Prof. Larmor, Mr. Kempe, Mr. Stromeyer, and a large number of other members of the board. The annual report of the executive committee, giving details of the work since the opening of the laboratory by H.R.H. the Prince of Wales, was approved. It appears from the report that subscriptions and donations amounting to nearly 1000*l.* a year have been promised by the Institution of Civil Engineers, the Iron and Steel Institute, the Institute of Chemical Industry and various private firms. Efforts are being made to extend the list, and more especially to render the laboratory self-supporting by increasing the work done for firms and private individuals. Examples of such work are given in the report, and in a lecture recently delivered at the Institution of Mechanical Engineers by the director. The scheme of work suggested by the director for 1903 was also approved. After the meeting an inspection of the laboratory took place, and in this the board was accompanied by a number of gentlemen who have assisted the laboratory by serving on its various committees or as donors of apparatus. Among the visitors were Sir Herbert Jekyll, of the Board of Trade; Sir Thos. Elliott, of the Board of Agriculture; Sir Wm. White, Commander Sclater, of the Admiralty; Sir Oliver Lodge, Mr. Dewar, M.P., the Master of the Mercers' Company, Col. Vickers, Mr. Smith Carington, of Messrs. Sir W. G. Armstrong, Whitworth and Co.; Mr. Swinburne, Mr. Ferranti, and many others.

The death is announced, at seventy-five years of age, of Prof. M. S. Voronin, member of the Imperial Academy of Sciences at St. Petersburg, and distinguished by his botanical work.

The U.S. National Geographic Society has awarded the Cullum medal to the Duke of the Abruzzi for his ascent of Mount St. Elias and his Arctic explorations.

The competition for the prize offered by the Academy of Verona for a historical and artistic guide of the city and province of Verona has been deferred until December 31, 1903.

It is announced in *Science* that Mrs. Rowland has given to the Johns Hopkins University the library of the late Prof. Rowland relating to spectroscopy, and a former student has given more than 1000*l.* to purchase books on this subject. With these gifts there will be established a "Henry A. Rowland Memorial Library," to contain publications in the field of radiation and spectroscopy.

Mr. Otto J. Klotz, astronomer of the Department of the Interior, Canada, leaves shortly for the Pacific, in charge of the longitude determinations along the British Pacific cable. It is stated in *Science* that the stations occupied will be Vancouver, Fanning, Suva, Norfolk and Southport, near Brisbane, Australia. Connection will also be made with New Zealand from Norfolk, where the cable bifurcates.

According to Reuter's Agency, Mr. Fiala, the leader of the new North Pole expedition which Mr. Ziegler is dispatching to the Arctic, is leaving at once for Norway to join the steamer *America*, which has been lying at Tromsö since the return of the expedition last year. Provisions and stores for two years will be taken, and on leaving Tromsö the *America* will steam direct for Archangel, where she will embark fresh supplies. Mr. Fiala states that the main idea is to make a forced march to the Pole from a base of supplies.

Prof. F. J. Studnička, whose death occurred on February 21, was a prolific and versatile author. The long list of his papers begins with two or three on physics proper, but his work was mainly in the field of pure mathematics. Among the subjects on which he wrote are determinants, chain-fractions, congruences, magic squares, the eight-square theorem in arithmetic, definite integrals, and quaternions. Meteorological questions seem to have interested him always, and he published several papers on rainfall. Besides all this he was the author of various mathematical treatises, and professor of mathematics in the University of Prague.

The tercentenary of the close of Queen Elizabeth's reign was celebrated by the Royal Geographical Society on March 23 at an interesting gathering, at which special stress was laid on the importance of that memorable reign as the starting point of progress in every branch of geographical science. The names of the great sailors of those days have become such household words that an occasion of the kind was hardly needed to impress upon the public the great results which have followed from those early beginnings of nautical enterprise. But it is far less generally recognised that the Elizabethan era was quite as important from the point of view of the more scientific branches of the subject, and this fact was clearly demonstrated by Sir Clements Markham in his opening address, in which the services rendered by such men as Hakluyt, Davis, Wright, Blundeville, and Saxton to the science of surveying and map-making was fully set forth. A special address by Prof. Silvanus Thompson emphasised the value of the work of William Gilbert as the first to reduce to a connected system the vague notions previously prevalent on the subject of magnetism, and showed that though by no means free from error, Gilbert's theories were the starting point from which the gradual elimination of those errors followed in due sequence. Short addresses by Mr. Edmund Gosse and Mr. Julian Corbett dealt with special aspects of the work of Raleigh and Drake, while an interesting exhibition illustrated the geographical achievements of the reign in the form of books, maps, instruments, and so forth.

In the House of Commons on Monday, in answer to a question with regard to the fitting of coastguard signal stations with wireless telegraphy apparatus, Mr. Arnold-Forster said:—The following stations have been established: Dover, Culver Cliff, Portland, Rame Head, Scillys, and Roches Point. The following are proposed to be fitted during the next financial year:—Bere Island, Spurn Head, Alderney, St. Abb's Head, St. Ann's Head, Languard, Port Patrick, Duncansby Head. As regards commercial signalling, it is proposed to carry this out from the stations which will be included in the new Lloyd's-Admiralty agreement, which are:—Culver Cliff, Scillys, Spurn Head, St. Abb's Head, St. Ann's Head, Duncansby Head, and Roches Point.

It is announced in the Boston *Transcript* that a plan has been definitely approved for holding an International Congress of Arts and Sciences at the St. Louis Exposition on September 19–September 30. The congress will attempt to correlate the scattered theoretical and practical scientific work of our time. In each of the various sub-

divisions two papers will be presented—one on the history of that particular department of knowledge during the past one hundred years, and the other on the problems that now present themselves for solution in that field. Profs. Simon Newcomb, of Washington, Hugo Münsterberg, of Harvard University, and A. W. Small, of the University of Chicago, have been entrusted with the arrangement of the details. It is expected that these three American men of science will spend shortly several months in Europe, conferring with leading European men of science with a view to secure their full cooperation.

THE *Atti dei Lincei* announces that the subject for the Carpi prize for 1903–4 is "Contributions to the Study of the Functions of the Liver in the Animal Series."

IN its *Rendiconti* (xxxvi. 1), the Reale Istituto Lombardo publishes its annual list of prize awards, and subjects for prizes for future years. The following prizes are unawarded:—The ordinary prize of the Institution, the Cagnola prizes for essays on the cure of pellagra and the steering of balloons, the Fossati prize, and the Secco Commeno prize. Under the Cagnola foundation, a prize of 2500 lire and a gold medal of 500 lire are awarded to Prof. G. B. Grassi, of Rome, for his works dealing with the nature of miasma and contagion. Under the same foundation, no other prizes have been awarded, but special awards of 800 and 700 lire have been made to two anonymous competitors on the subject of effect of fumes from manufactories on vegetation, and 1000 lire have been similarly given to one competitor on the subject of prevention of forgery of documents. The Kramer prize of 4000 lire has been awarded to Carlo Valentini, engineer, for his work on the prediction of the floods of the Po. In connection with the Zanetti prize for Italian pharmacists, 700 lire have been awarded to Prof. Egidio Pollacci (Pavia), and 300 lire to Edoardo Baroni (Turin). For the Brambilla prize for manufacturers of Lombardy, seventeen competitors have entered, and the commission has awarded a gold medal and 600 lire to Dr. Daniele Crespi for mercerisation of cotton, &c., the same to Pastori and Co., steel pen makers, a gold medal and 400 lire to Marx and Co. for table cutlery, the same to Besana, Felice, Comi and Co. for hot water and steam heating apparatus, to Ercole Marelli and Co. for electric ventilators, and to M. Boschi and Co. for transparent glass plates for pavements. Awards of 300 lire have been made to Angelo Mantegazza for Italian paste, and to Biagio Bigioggero for seamless upper leathers for shoes. As in previous years, the awards indicate keen competition and progress by rapid strides among the Lombardy manufacturers, while the subjects in pure science attract comparatively few competitors.

FOR future prize competitions, the Reale Istituto Lombardo gives a programme of which the following is a brief summary. The Institution prize for 1903, for developments of Lie's theory of groups; for 1904, on the work of Vittorio Alfieri; the two triennial medals for 1903, for the promotion of agriculture and the introduction of manufacturing industries in Lombardy. The Cagnola prize for 1903, for a monographical study of hypophysis; and for 1904, on the velocity of kathodic rays. The Cagnola prizes on subjects chosen by the founder, cure of pellagra, nature of miasma and contagion, direction of balloons, and prevention of forgery. The Brambilla prize, for manufacturing industries in Lombardy. The Fossati prize for 1903, on the so-called nuclei of origin or termination of cranial nerves; for 1904, on the localisation of cerebral psychic motory or sensory actions; for 1905, on our state of knowledge in neurology. The Kramer prize for 1903, on systems of electric traction. The Secco Comneno prize, on the virus of rabies; Ciani prizes, for published books of the following classes—historical for 1903, narrative or dramatic for 1906, scientific (with preference to philosophy and education) for 1909, the book in each case to have appeared within the eight years preceding the award; also an extraordinary Ciani prize for 1904 for an unpublished Italian popular book. The triennial Zannetti prize for 1905, for progress in pharmaceutical chemistry. Finally, the Tommasoni prize for 1905 is for the best history of the life and works of Leonardo da Vinci.

BY the death, at the early age of fifty-eight, of Dr. Gustav Storm, professor of history at the University of Christiania, Norway in particular, and the world of scientific historians in general, have sustained a loss which it will take a long time to repair. In his own university, his superior intellectual qualities, his indefatigable energy and high character secured for him a position of unique importance and influence; while abroad he was looked upon as the typical representative of scientific research in the wide domain of history. As the main task of the man of science is to weigh and measure with the greatest possible accuracy, so Storm made it his chief business to sift with the utmost minuteness the secondary from the primary sources of historic evidence, and on the results obtained to measure time and truth in history. The only work of his we know of which, in this respect, fell short of success was his "Critical Contributions to the History of the Viking Age" (1878), directed against the redoubtable author of "Normannerne," Prof. Steenstrup, of Copenhagen, and referring to the everlasting contest between Norwegian and Danish historians on the question as to which of their respective nations can lay the best substantiated claim to the lion's share in the glory of the *furor Normannorum*. At the age of seven-and-twenty (1872), Storm won the gold medal of the Royal Society of Copenhagen for a singularly thorough and lucid treatise on the sources, manner and method of the historical writings of Snorri Sturluson, a work which still maintains its standard authority unimpeached. Two years afterwards he published another work of standard value, in which he submitted to a searching criticism the legendary cycles round Charlemagne and Theodoric the Goth with a view of ascertaining what historical elements lay hidden under the heap of mediæval romance. In 1877 he was appointed to the chair of history; in 1883 he was elected perpetual secretary general of the Royal Society (Videnskubernes Silskab) of Christiania; in 1886 he became perpetual chairman of the commission for editing the "Fontes" of Norwegian history. He was the author of a large number of important works, and contributed numerous important papers to the *Transactions* of the Royal Society of Christiania, to *Historisk Tidskrift*, to *Aarböger för nordisk Oldkyndighed*, to *Arkiv för nordisk Filologi*, besides a yearly review, from 1876, on Norwegian historiography to the *Revue Historique*.

A SMALL pamphlet entitled "Über die neueren Dämmerungserscheinungen," by Herr P. Gruner (extract from *Mitteilungen der Naturforschenden Gesellschaft in Bern*, 1903), contains some facts relating to the appearances of coloured sunrises and sunsets during last year caused by the volcanic eruptions in the West Indies. Herr Gruner, from a discussion of the days in each month when this phenomenon was observed, suggests that they indicate a periodicity corresponding with the times of new moon. That this may be so seems more natural than otherwise, since the bright moon in the sky would most probably have a tendency to render very difficult the observation of this phenomenon.

PROF. H. HILDEBRAND HILDEBRANDSSON has just issued the first portion of his report to the International Meteorological Committee on the International observations of clouds, which contains, as an introduction, an interesting summary of the history of the general circulation of the atmosphere. The volume includes the results of computation of all observations of cloud movements which he has been able to collect, the mean directions being determined by the "résultantomètre" of M. Sandström, which gives them to one or two degrees. Numerous plates, twenty-two in all, accompany the report, twenty of which give the mean directions of the wind each month, and for several places scattered over the earth's surface. The book is a valuable contribution to this branch of meteorology.

THE Danish Meteorological Institute has published its valuable annual statement relating to the state of the ice in the Arctic seas in 1902, with charts for each month, from March to August. Some of the general results show that the winter ice broke up very late, that the Polar ice lay nearer Asia and Europe than usually, and that the number of icebergs carried from Greenland to the temperate seas was notably smaller than usual. Also that the summer of 1902 has been rough and unsettled in nearly all Arctic and sub-Arctic regions, northerly and easterly winds predominating in Atlantic Arctic seas. No safe conclusions for 1903 can be drawn from the limited data available, but conditions appear favourable for the passage of a considerable number of icebergs east of Labrador and Newfoundland.

WE have received the "Instructions to Observers of the Indian Meteorological Department," by Sir John Eliot. This book, which is the second edition, is intended to supersede the Indian meteorologist's vade-mecum, now out of print. It is confined simply to a description of the various instruments in use at the meteorological stations in India, the precautions to preserve them in good condition, the methods to restore them to good order when it is possible for the observer to do so, and the proper methods of reading the instruments and of taking and recording the observations. It may be mentioned that these "instructions" are so limited because at the present time the observers in India merely take the readings of certain instruments and forward them on suitable forms to the head office, all the work of reduction and preparation for subsequent use and discussion being done there. For this reason explanations as to the methods of applying corrections, and the procedure of reduction, &c., are absent. The book, however, will be useful nevertheless to observers not stationed in India, especially that portion showing the conditions to be fulfilled in the selection of a site for a meteorological station.

ACCORDING to the *Daily Mail*, six of the Cunard Steamship Company's liners have been equipped with printing machinery for the publication of a paper the news of which is supplied by wireless telegraphy. A facsimile of the front page of the paper published on board the *Etruria* and called the *Cunard Bulletin* was printed in the *Daily Mail* of March 14.

AN interesting paper on distribution losses in electricity supply was read by Messrs. Constable and Fawssett before the Institution of Electrical Engineers. The figures given in the paper have been obtained from the working of the Croydon central station, which has an output of 1250 k.w. Roughly, the total losses amount to 21 per cent. of the units generated, and are divided up as follows:—Switchboards and connections, 0·5 per cent.; cable losses, 8·5 per cent.; transformer losses, 9 per cent.; and meter losses, 3 per cent. The authors consider the losses under each heading separately, and suggest ways in which they may be reduced; the greater part of the paper is devoted to the cable losses, which are the most important and the least easy to reduce.

SOME measurements of the temperature coefficients of magnets made of chilled cast iron are described by Mr. B. O. Peirce in the *Proceedings* of the American Academy of Arts and Sciences. Castings of a size and shape suitable for instrument magnets gave for the temperature coefficient between 10° C. and 100° C. mean values of from 0·0003 to 0·0004. These castings had been subjected to a chilling process at the Jefferson Physical Laboratory; another similar magnet treated by an outside maker had the coefficient 0·0008. Unchilled castings were found to have a coefficient five or six times as large as the chilled magnets. The temperature coefficient generally increases with the temperature, the value between 10° C. and 40° C. being possibly only about one-third of the mean value between 10° C. and 100° C. Using such magnets as these in conjunction with galvanometer coils of copper and manganin it is easy, according to the author, to construct a cheap ammeter almost wholly independent of the room temperature.

OUR contemporary the *Electrical Review* has recently published some particulars of the new storage battery invented by Mr. Edison which we described in NATURE more than eighteen months ago (vol. lxiv. p. 241). It seems that the cell is likely soon to be put on the market, and Mr. Edison is reported as having expressed himself as fully satisfied with the trials, and confident of its ultimate success. "The experimenting with the new battery has all been done," he said, "and the only thing that remains is to adapt it to the use of the public." Mr. Hibbert, in the articles referred to above, publishes some discharge curves communicated to him by Mr. Edison's associate, Mr. Dick, which are very similar to the curve which was published in NATURE; the most noticeable point is the large percentage of the ampere-hour discharge obtained at high discharge rates; with eight times the normal discharge rate the cell has 75 per cent. of its normal capacity, which is a very much better performance than that of any lead cell. The watt-hour capacity per pound is the same as originally claimed—about 11—and the cells are said to be of very good mechanical construction and durability. The result of practical experience of the cell in ordinary working will be awaited with great interest; it certainly seems as if we are a step nearer to the production of a satisfactory automobile cell, and to the ousting of lead from its present position as the only material suitable for secondary batteries.

THE December issue of the *Bulletin de l'Académie des Sciences de Cracovie* contains a paper by Prof. Olszewski dealing with three forms of apparatus for the liquefaction of air and hydrogen. Each apparatus is based on the principle of Dr. Hampson's well-known machine; two of them serve to liquefy air, the third is a hydrogen liquefier which can also, if necessary, be used to liquefy air. The first apparatus is intended for use in laboratories when greater quantities of liquid air are to be prepared in a shorter time than it is possible to do by means of the Hampson liquefier. This result is attained by dividing the coil of the Hampson machine into two parts, and inserting between them a CO_2 cooler. The yield of the apparatus is thus doubled. The second apparatus is a true Hampson liquefier, simplified and reduced in size, and wholly enclosed in a partly silvered vacuum vessel. This serves to demonstrate the liquefaction of air during a lecture, without use of a compressor, by means of air compressed

in a steel flask. The last apparatus described is a hydrogen liquefier which differs from that of Dr. Travers chiefly by the insertion of a second regenerator coil, which serves almost wholly to equalise the temperatures of the arriving and the issuing hydrogen, and by the absence of a low pressure chamber for liquid air, this refrigerant being used boiling under atmospheric pressure. The preliminary experiments carried out with this apparatus are said to have led to satisfactory results.

A series of articles by Prof. Duhem, of Bordeaux, on the evolution of mechanics, is an important feature of the current numbers of the *Revue générale des Sciences*. It commences in the issue of January 30 with a historical account of the development of dynamics, starting with the Greek notions of matter, and tracing the successive theories of Descartes, Leibnitz, Boscovich, Newton and Laplace. In the second part, Prof. Duhem deals with the principle of virtual velocities and the statics of Lagrange, d'Alembert's principle, the Lagrangian equations of motion, the theories of Poisson on elasticity, hydrodynamics and capillarity, and theories of elasticity generally. The third paper is devoted to Prof. Duhem's favourite subjects of study, heat and electricity, especially the former. The kinetic theory of gases is traced from its first introduction in the "Hydrodynamica" of Daniel Bernouilli down to the latest works of Boltzmann. In the section devoted to thermodynamics, we have an account of the discoveries of the first and second laws, Helmholtz's theory of monocyclic systems, and a detailed examination of Gibbs's recent work on statistical mechanics. The dynamical theories of electricity are considered, with especial reference to Clerk Maxwell. Finally, under "Impossibility of Perpetual Motion," we have a critical exposition of the dynamics of irreversible phenomena and Clausius's principle of entropy. Further papers are promised dealing with the revival of atomism, the foundations of thermodynamics and similar subjects. On all these branches of theoretical physics Prof. Duhem speaks with authority, and his papers form a useful summary of the development of modern views of the dynamical properties of matter.

The *Naturalist* for March contains an account of the work of the Yorkshire Boulder Committee for 1901–2.

In *Naturwissenschaftliche Wochenschrift* of March 8 Herr L. Plate concludes his account of Weismann's theory of development.

We have received the *Transactions* of the City of London Entomological and Natural History Society for 1902, which contain the president's address and a number of papers.

Dr. O. Zacharias, in *Biol. Centralblatt* of March 1, gives an account of the plankton of the Thames, based on the investigations recently undertaken by Dr. F. E. Fritsch, of the Jodrell Laboratory at Kew.

The *Anales* of the National Museum of Buenos Aires (vol. i. part ii. of the third series) contains three papers by Dr. Ameghino. In the first of these, the author describes a number of mammalian remains—mostly fragmentary—from the well-known deposits of Tarija, in Bolivia, naming several species as new. The age of the Patagonian mammaliferous deposits forms the subject of the second communication; while in the third the primitive type of mammalian molar teeth is discussed.

An interesting account of the mode of life of the giant land tortoises of the Galapagos Islands, and the present condition of the different species, is given by Mr. E. Heller in vol. v. of the *Proceedings* of the Washington Academy. From several of the islands of the group, the tortoises have disappeared; in Indefatigable Island, the extermination appears to have been quite recent, some Ecuadorians having told the author that not many years ago they saw a huge tortoise near the central crater. The land and sea iguanas of the Galapagos, and their habits, also come in for a share of attention, the author describing the land iguana of Barrington Island as a new species, under the name of *Conolophus pallidus*.

A memoir on the geology of the country around Salisbury, by Mr. Clement Reid, has just been issued by the Geological Survey. It is accompanied by a capital colour-printed map, and both will no doubt be welcomed by the members of the Geologists' Association who make Salisbury their head-quarters for an excursion at Easter. The famous vale of Wardour, with its Portland and Purbeck strata at Tisbury and Chilmark, the Greensand and Chalk of the bordering heights, the Chalk of Salisbury Plain, and the Tertiary and Pleistocene deposits are duly described. It is interesting, too, to find approval of the Eolithic implements which Dr. Blackmore has so assiduously gathered together from the pits of Alderbury.

M. Charles Rabot, secretary of the French Commission on Glaciers, is the author of a pamphlet entitled "Essai de Chronologie des Variations Glaciaires" (extract from *Bulletin de Géographie Historique et Descriptive*, No. 2, 1902). In this work the author discusses the observations which he has collected from numerous places in different parts of the world, and comes to some interesting conclusions, which he summarises at the end. To state in a few words the results obtained, he points out that the same kind of glacial variation does not occur simultaneously in the regions he investigated; thus the last positive variation extended over a century and a half, the beginning of the primary increase occurring in Norway in 1700, and ending in the Alps in 1855–1860. A complete primary oscillation, *i.e.* an increase and decrease, appears to have a duration of one or two centuries. For Norway, for instance, the last primary increase began in 1700, and the decrease has not yet terminated; many other examples are given. There seems further to be a plurisecular period covering, in the case of the Alps, about three centuries.

The Gresham Publishing Company has published, in drawing-book form, two capital models to show graphically the structure of the bee. One model is of the queen bee, the other of the drone. By the familiar device of overlapping sheets, suitably shaped and coloured, the external anatomy, the organs of respiration, digestion and reproduction, as well as the nervous system, can be followed by successively raising the sheets, which, when folded down, make realistic models of the two bees.

The fourth instalment has been issued of the report on the physical and chemical soil survey of Dorsetshire, begun in 1898, and being conducted by the Department of Agriculture of the Reading University College. In an introductory note Prof. Percival, the director of the Agricultural Department, says it is hoped that during the present season an examination will take place of the flora and plant associations, more especially of the pastures and meadows, met with upon the different formations and drift areas of Dorsetshire. A thorough botanical or œcological survey taken in conjunction with geological and analytical data will be of great value, and it is proposed, if possible, to secure the assistance of Dorset field botanists.

A second enlarged edition of Prof. A. Fischer's admirable "Vorlesungen über Bakterien" has been published by the firm of Gustav Fischer, Jena. The first edition was published in 1897, and was very favourably reviewed in these columns (vol. lviii. p. 77, 1898). The book is now double the size of the original volume, the number of pages having been increased from 186 to 374. Its value as a scientific treatise on bacteriology has thus been increased, and students of the subject may turn to the book with confidence that they will find the present state of knowledge of bacteriological science satisfactorily represented in it.

The additions to the Zoological Society's Gardens during the past week include a Bosman's Potto (*Perodicticus potto*) from West Africa, presented by Captain Jas. Startin, R.N.; a Rhomb-marked Snake (*Trimerorhinus rhombeatus*) from South Africa, presented by Mr. George Vanderspar; six Marbled Newts (*Molge marmorata*), three Palmated Newts (*Molge palmata*), three Brown Newts (*Spelerpes fuscus*), European, deposited; two Herons (*Ardea cinerea*), European, received in exchange.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in April:—

April 6. 10h. 11m. Minimum of Algol (β Persei).
9. 11h. 48m. to 12h. 23m. Moon occults υ Leonis (mag. 4·5).
9. 15h. 16m. to 18h. 48m. Transit of Jupiter's Sat. III. (Ganymede).
11. Moon partially eclipsed visible at Greenwich:—
10h. 34·4m. First contact with the shadow.
12h. 13·0m. Middle of the eclipse.
13h. 51 6m. Last contact with the shadow.
Magnitude of the eclipse (☽'s diameter = 1) = 0·973.
15. Venus. Illuminated portion of disc = 0·832, Mars = 0·985.
20–22. Epoch of Lyrid meteoric shower (Radiant 271° + 33°).
26. 11h. 54m. Minimum of Algol (β Persei).
29. 8h. 43m. Minimum of Algol (β Persei).

Stellar Parallax.—The *Transactions* of the Astronomical Observatory of Yale University (vol. i. part vi.) contain a valuable determination of the parallax of the ten first magnitude stars in the northern hemisphere by Dr. W. L. Elkin, the director of the Observatory. This investigation is part of a scheme for making a series of researches on the parallaxes of stars of successive orders of magnitude with the Yale heliometer, and was begun in the year 1885. In the volume before us Dr. Elkin gives details of the method of measurement adopted, the several series and comparison stars, the observations and reductions, and finally a discussion of the results. Referring here only to the actual results he obtained, the following table gives the adopted values of the parallax of each of the stars, with their probable errors:—

	Adopted Parallax.	Probable Error.
	"	"
α Tauri	+0·109	±0·014
α Aurigæ	0·079	0·021
α Orionis	0·024	0·024
α Can. Min. ...	0·334	0·015
β Geminorum ...	0·056	0·023
α Leonis	0·024	0·020
α Bootis	0·026	0·017
α Lyræ	0·082	0·016
α Aquilæ	+0·232	0·019
α Cygni	−0·012	±0·023

Measures of Saturn's Rings.—A series of measurements of the distance between the inner edge of the inner ring of Saturn and the planet itself has been made by Prof. F. E. Seagrave, of Providence. The mean result obtained shows a distance of 3″·698 on the preceding side and 4″·005 on the following side, and the diameter of the planet itself is given as 17″·618.

A comparison of this result with the mean of the results obtained by previous observers shows that there is no proof of the theory, first advanced by M. Struve in 1851, that the inner ring of the planet was expanding inwards, and that consequently the space between it and the planet was decreasing (*Popular Astronomy*, No. 103).

Observations of Jupiter's Fifth Satellite.—In *Bulletin* No. 28 of the Lick Observatory, Prof. R. G. Aitken gives the details of the measurements made during 1900 and 1902 at the Lick Observatory of the positions of Jupiter's fifth satellite.

In each set of observations the position of the satellite is referred to that of one of the others, and the time of observation, the position angle, the distance in seconds and the number of settings are given in tabular form.

The satellite was observed on ten nights, a magnifying power of 270 being used during 1900, and a power of 350 during 1902. During the former period the planet itself was occulted by means of a drop of Indian ink on a clear glass plate placed between the micrometer threads and the eye-piece, but during 1902 a piece of suitably placed smoked mica was substituted for the glass plate.

Observations of the Light of Nova Persei.—The second publication, by the Harvard College Observatory, of the variations in the magnitude of Nova Persei occurs in vol. xlviii. (No. 2) of the H.C.O. *Annals*.

About three thousand six hundred magnitude observations have been compiled from various sources by Mr. Leon Campbell, under the direction of Prof. O. C. Wendell. The time of observation, the original comparison stars (when available), the magnitude of the Nova reduced to the Harvard photometric scale, the name of the observer and a reference number to the publication in which the observation was originally recorded are given for each observation, and the observations are set out in chronological order.

New Catalogue of Double Stars.—A sixth catalogue of one hundred double stars, discovered by Mr. W. J. Hussey whilst using the 12-inch and 36-inch Lick refractors, is contained in *Bulletin* No. 27 of the Lick Observatory. The previous five catalogues, each containing the names, positions and particulars of one hundred new doubles, have appeared in earlier numbers of the *Astronomical Journal* and the Lick *Bulletins*.

Mr. Hussey calls special attention to two of the stars in the present catalogue, Nos. 507 and 580 respectively. No. 507 (D.M.+49°.95) is a remarkable triplet the components of which are of nearly equal magnitude (A.=9·3m., B.=9·5m., C.=9·8m.) and form an equilateral triangle, and the observer suggests that the measurements thereof should form a conclusive test for determining personal equations. No. 580 (ι Serpentis) is a probable binary the components of which are equal in magnitude (5·0m.) and the proper motion exceedingly small, viz. −0·00477s. and −0″·0582.

Magnetic Observations During Eclipses.—Dr. L. A. Bauer, of the Coast and Geodetic Survey, Washington, has collected all the available observations of the magnetic variations which are shown to take place during a total eclipse of the sun, and has published them in No. 4, vol. vii. of *Terrestrial Magnetism and Atmospheric Electricity*.

It is suggested in the preface to the article that the eclipse variation of the magnetic needle is analogous to the common diurnal variation, and that the causes of the two phenomena are also analogous, inasmuch as the diurnal variation may be caused by the continual eclipse of that side of the earth which, for the time being, is turned away from the sun. For this to be the case we have to premise that these variations are caused by some undetermined radiation from the sun which affects the magnetic needle.

This suggestion is supported by the following result deduced from the collected observations, which refer to every eclipse that has taken place since 1870:—"The precise effect of the eclipse magnetic variation is (1) opposite in the two magnetic hemispheres; (2) opposite for the morning and afternoon hours." In other words, "the nature of the eclipse variation is analogous to that of the diurnal variation, differing from it only in degree."

Supposing that the magnitude of the effect produced varies

proportionately with the amount of sunlight cut off, the earth and moon should produce effects inversely proportional to the square of their diameters, *i.e.* 13·5 : 1, and in analysing the collected data Dr. Bauer finds that the ratio of the diurnal variation to the eclipse variation is of this order, thereby supporting the theory set forth in the preface.

THE SOLIDIFICATION OF FLUORINE AND THE COMBINATION OF SOLID FLUORINE WITH LIQUID HYDROGEN.[1]

In preceding researches we have shown that fluorine is liquefied at $-187°$ C., and that, at this low temperature, it acts neither upon crystallised silicon, amorphous carbon, boron nor mercury; that, in short, its chemical activity is diminished, but that it still combines with production of flame with hydrogen and solid turpentine.

These researches have been continued since one of us has been able to obtain hydrogen in the form of a stable liquid boiling at $-252°·5$ C., or at $20°·5$ absolute. Since the first experiments published on this subject it has been found that fluorine which is perfectly free from hydrofluoric acid does not attack glass at the ordinary temperature; hence it is now possible to enclose a definite volume of fluorine in a thin-walled glass vessel, and to submit it to the powerful cooling action furnished by the ebullition of liquid hydrogen.

A sealed glass tube filled with fluorine and placed in liquid oxygen, boiling quietly under the atmospheric pressure, showed no trace of condensation. The same tube was lowered slowly into a double-walled vessel containing liquid hydrogen, so as to obtain a progressive cooling. A yellow liquid first appeared, which, after plunging wholly into the liquid hydrogen, froze to a yellow solid. On leaving the tube for some time in the liquid hydrogen, so that the temperature of the fluorine was cooled down to $20°·5$ absolute, the solid fluorine, originally yellow, became white, resembling in this respect chlorine, bromine and sulphur. Experiments with liquid nitrogen showed that the melting point of fluorine is below $-210°$ C., and a comparison with the melting point of oxygen, 38° absolute, showed that 40° absolute, or $-223°$ C., is the most probable value for the melting point of fluorine. The ratio of the melting point to the boiling point is a little smaller than the ratios given by chlorine and bromine.

Experiments were also directed to another point, the question of the affinity of bodies for each other at low temperatures, and in view of the fact that fluorine possesses more powerful affinities than any other elements, it was interesting to determine whether any action was possible between liquid hydrogen and solid fluorine, both maintained at a temperature of $-252°·5$. In order to realise this experiment, a thin glass tube was taken containing about 50 c.c. of gaseous fluorine, which had been completely freed from hydrofluoric acid, the gas completely solidified in one of the points of the tube, and this then immersed in a hundred cubic centimetres of liquid hydrogen. When the temperature of the whole was lowered to that of the liquid hydrogen, the point containing the fluorine was broken off without removing the tube, so as to allow of contact between the hydrogen and the fluorine. A violent explosion was the result, sufficient heat being set free to raise the material to incandescence and to set fire to the hydrogen. The explosion was sufficiently powerful to reduce the fluorine tube and the double-walled hydrogen vessel to powder.

Helium is now the only gas which has not been obtained in the solid state.

THE ACCUMULATION OF METEOROLOGICAL OBSERVATIONS.

Prof. Hann contributes to the *Meteorologische Zeitschrift* for January a translation into German of that portion of Prof. Schuster's address before the British Association at Belfast (Nature, vol. lxvi. pp. 614–618) which deals with meteorological observations, and adds some comments from which the following extracts are translated.

Prof. Schuster's point of view is that of the theoretical physicist, and it is consequently different from that of the meteorologist, who cannot leave the demands of practical life out of account.

The professor's remarks as to the desirability of short and systematic series of observations for the study of definite problems, that is to say, the introduction of a kind of experimental method into meteorology, will certainly meet with universal approval, but this has already been done in several cases (study of thunderstorms, effect of forests on climate, &c.). Simultaneously with such special observations the regular "routine observations" need in no wise be neglected; they appear to us to be indispensable.

Complaints as to the superabundance of meteorological observations are not new; it may be a quarter of a century since we read in an English periodical: "The need in meteorological science now is not observations, but brains to work out the results." It cannot be denied that there is some justification for this point of view, but it must be borne in mind that by reducing the number of meteorological records the number of "brains" who would discuss already available observations would hardly be increased.

A small amount of consideration will further show that the question of a temporary suspension of meteorological observations cannot be regarded as a practical one. The central institutions could take no such step, for they are not intended solely, or even primarily, to serve the ends of pure science, but chiefly to meet the demands of practical life, which would not brook the interruption of observations for a lustrum. The answer given by Sir George Airy before a Treasury Committee appointed to inquire into the expenditure of the grant in aid of meteorology is characteristic in this connection. Asked whether there were reasons for continuing the publication of the detailed daily reports from the seven (first-class) observatories, Airy replied: "It is desirable they should be preserved, I think; and there is one point which is worth considering, and that is that the public feeling in favour of meteorological publications is very strong. . . . I get a great number of letters and applications of all kinds from persons that I know nothing about. Few requests are made for astronomical information. A greater number are made for magnetic information, but that is to a great extent for practical purposes; but I think that by far the greater number are for meteorological information. . . . Popular feeling is an element not to be put out of question in matters of this kind." This from the same Airy who later on expressed the wish "that an absolute stop should be made from time to time in order to give what I venture to call breathing time." But practical and scientific demands alike pass over such desires.

Had Prof. Schuster ever been at the head of a meteorological office, he would know how constantly public authorities, to say nothing of private individuals, demand authentic meteorological data; he would then be able to estimate what public opinion would say if the director answered: "I have discontinued meteorological observations for five years, to obtain time and opportunity for discussing existing records."

Even if official observations were suspended, private observations would be continued, and a state of affairs would again be brought about similar to that which obtained before the introduction of an organised system of observation. Unchecked observations would be made with untested and badly exposed instruments, and a real waste of time would result, nay more, in many cases positive harm might be done by the circulation of inaccurate data. A natural interest, which has undoubtedly done good service in the past, would also be checked.

As regards the publication of results, it is only by means of such publications that it is possible on the one hand to exercise satisfactory supervision over the observations, and on the other to give all who desire it the opportunity of making use of existing records. To bury the results where they would be accessible only to the staff of an office would be a waste that would indeed justify complaints.

Least of all can we understand how Prof. Schuster could mistake the value of continuous homogeneous records or

[1] A paper, by Profs. H. Moissan and J. Dewar, read before the Paris Academy of Sciences, March 16.

the extent of the injury that would be inflicted on the objects of such observations by a temporary interruption of the same. A large number of the problems presented by the physics of our globe can only be attacked with any hope of success from this basis; it is essential to have a number of well supervised principal stations in each country supplying an uninterrupted homogeneous series of observations. These stations are also of service in the study of climatological history, and are destined to prove of great importance in the study of meteorology in the future.

Only in a limited sense can we agree with Prof. Schuster's dictum that before commencing to observe we should make sure that our observations will prove of service, and will give answer to a definite question. Not even in the case of observatories do such instructions hold good. When addressed to private observers we would characterise them as "blinkers" which limit the range of vision to definitely laid down lines. We quote one example: when Schwabe began his sun-spot record, it must have appeared to specialists as a mere hobby, devoid of all scientific object; had it been otherwise astronomers would undoubtedly have commenced such observations earlier. And what scientific value have these observations now attained to?

LEAD IN PEATY WATER.[1]

THE report under notice is a statement of the results obtained from an examination of the water supplies and their gathering grounds and storage reservoirs in twenty-three more or less peaty collecting areas in Yorkshire and Lancashire. The object of the examination was to indicate the origin of the plumbo-solvent nature of these waters, and the best methods of preventing or counteracting this action before the water was distributed to consumers. Dr. Houston concurs with Mr. Ackroyd and with other chemists who have studied the subject in these districts in attributing the power of dissolving lead in dangerous quantity to the presence in these waters of acids derived from the peat; and he further intimates his belief that the acid is produced from the peat by the action of certain bacteria found in the peat itself. He finds that the acid nature of the water is frequently not indicated by litmus paper or by other ordinary means, but that it is easily ascertained by the change in colour produced in an alcoholic solution of lacmoid.

The "erosive" action which is exerted on dull lead by dissolved oxygen is considered to be of relatively slight importance, since, in the absence of peaty acids, the amount of solvent action due to this cause is comparatively slight. The peaty acids apparently produce soluble salts of lead and cause the water to bring a much larger proportion of lead into solution than could be introduced by the formation and solution of the oxide alone. Peat is invariably acid in reaction, and peaty water is also always acid. That the solution of the lead by moorland water is due to the peaty acids which it contains has been proved by direct experiment. Further, a decrease of plumbo-solvent power is noticed when these acids are reduced in quantity by various natural causes, or by artificial neutralisation. Indeed, the methods of counteracting plumbo-solvency in peaty water which are adopted in the moorland districts consist in neutralising the acids in the water with carbonate of soda, with carbonate of lime, or with slaked lime. In this connection, it should be remembered that the quantity of slaked lime used must be carefully adjusted, since when it is present unaltered in solution in the water it promotes and does not diminish the plumbo-solvent power.

The variation in degree of solvent action shown by the same moorland supply at different times is shown to be connected with the varying proportions of acid peaty water and of neutralising spring water which the supply contains. In dry weather, the neutral and neutralising water predominates, while rainy weather tends to increase the proportion of superficial acid water which comes out of the peat; these variations in composition markedly influence the plumbo-solvent power of the water.

The author appears to have confined his attention to the amounts of lead in solution in the water, and, undoubtedly, these are the common sources of danger. But a not inconsiderable amount of lead may be removed from the metal, and exist at first in solution as hydroxide, and subsequently as a deposit of hydroxycarbonate, when pure soft water acts on lead in the presence of the atmosphere; in water supplies this action is often considerably restricted by the presence of carbonic acid in solution in considerable proportion, or by the presence of silica, sulphate or carbonate in small amount.

The vast amount of detailed information contained in the report is worthy of serious consideration by those who have to deal with the supply of soft peaty water, as is also the recommendation that the seasonal plumbo-solvent power of the different sources from which any particular supply is derived should be accurately known; arrangements can then be made either to avoid the collection of portions of the supply at the times when they possess a dangerous solvent power on lead, or to neutralise them by satisfactory treatment before they are distributed to consumers. F. C.

[1] Thirtieth Annual Report of the Local Government Board, 1900-1901. Supplement "On Lead Poisoning and Water Supplies." By Dr. Houston. Pp. xi + 224.

PROGRESS OF THE NEW VEGETATION OF KRAKATÂO.

IT is within a few months of twenty years since the great eruption took place which absolutely killed all life in the island of Krakatâo. About three years later, Dr. Treub visited the island and examined the beginnings of a new vegetation, the results of which were recorded in 1888 (NATURE, vol. xxxviii. p. 344). He found that the first vegetable settlers on the covering of pumice-stone, lava and ash were microscopic algæ belonging to the Cyanophyceæ. These organisms covered the surface with a slimy layer, which acted as a decomposing agent and created a suitable substratum for ferns, of which about a dozen species were already abundant in 1886. Dr. Treub also observed a few individuals of fifteen species of flowering plants, most of which had sprung from drift-seeds.

In the spring of 1897, a party of botanists visited the island, and Dr. O. Penzig has published the results of their investigations and observations (*Annales du Jardin Botanique de Buitenzorg*, 2me série, iii. (1902), pp. 92-113, with seven views), from which we learn that sixty-two species of vascular plants were observed on Krakatâo and the neighbouring islets, Lang and Verlaten. Fifty of these colonists are flowering plants, representing twenty-one natural orders, and it seems highly probable that they all reached the islands independently of man. Classifying these fifty-three species according to the assumed means by which their seeds were conveyed to the islands, 7·54 per cent. were possibly carried by birds, 32·07 per cent. were probably wind-borne and 60·39 per cent. were almost certainly cast up by the waves of the sea. No additional species of fern appears to have established itself in the islands between 1886 and 1897. This is inexplicable, because the region is rich in ferns, the spores of which, one would suppose, would be brought by winds in abundance. Apart from ferns, the probable "aeolophilous" element consists of eight Compositæ, six grasses and four orchids. After passing the strand belt of vegetation, which is by far the most numerous in species, dense thickets of Phragmites, Saccharum and Gymnothrix were encountered. The interior and higher part of Krakatâo is still much less covered with vegetation, ferns largely preponderating. Conspicuous and relatively common amongst the flowering plants was *Spathiglottis plicata*, a terrestrial orchid. The other orchids are *Vanda Sulingi*, *Arundina speciosa* and a species of Phajus. Krakatâo is about twenty miles distant from both Java and Sumatra, and the most interesting question suggested by the new vegetation is, How far does it afford a solution of the problem of the origin of the vegetation of much more remote islands which have more than a littoral or coral island flora?

W. BOTTING HEMSLEY.

ANTHROPOLOGICAL NOTES.

THE strange cranial deformation known as trigonocephaly, in which the forehead is constricted and more or less pointed, and the temporal region and the base of the skull are broadened, is the subject of a research by Dr. M. Hanotte in *l'Anthropologie* (tome xiii. No. 5, p. 587).

The weight of the human brain is the subject of a detailed

nvestigation by Mr. F. Marchand (*Abhandl. der math. phys. Classe der Konigl. Sächs, Ges. der Wiss.*, No. 4, 1902, p. 393). The average weight of the brain for men between fifteen and fifty years of age is 1400g., that for women 1275g. The smaller size of the female brain is not dependent on shorter stature, as the median brain weight of women is absolutely smaller than that of men of similar size.

The *Mittheilungen der Deutschen Gesellschaft für Natur- und Völkerkunde Ostasaiens* (Band viii. Theil 3) contains two long articles, one by Mr. P. E. Schiller on the etiquette of present-giving in Japan, which is full of quaint customs, and another by Prof. Karl Florenz on the new agitation against the Japanese letter-forms. These, which are of Chinese origin, weigh like an intolerable burden on Japanese progress. Dr. Florenz adds an elaborate essay on comparative European and Japanese phonetics, illustrated by numerous diagrams of palates. This appears to be a valuable contribution to the subject of comparative phonetics.

The interesting excavations in the caves of Baoussé-Roussé, undertaken by the liberality of the Prince of Monaco, under the able direction of M. l'Abbé de Villeneuve and with the assistance of M. Lorenzi, the enthusiastic and skilful *préparateur*, have resulted in important discoveries. The work has been accomplished with the greatest thoroughness and exactitude. Dr. R. Verneau has published in *l'Anthropologie* (tome xiii. No. 5, p. 561) an illustrated account of his study of the remains from the "Grotte des Enfants," in which he states that although the Cro-Magnon type of man is found at a depth of 7m.·05, at ·70m. lower two skeletons were found which presented a very clear negroid appearance, but they are not true negroes. His hypothesis is that earlier than the race of Cro-Magnon and later than the race of Spy, a third ethnic element was present on the Riviera which presented negroid characters.

We have frequently directed the attention of ethnologists to the mine of information concerning the customs, beliefs and handicrafts of civilised and uncivilised folk that is to be found in the pages of our contemporary *Globus*. The articles are generally a record of first-hand observations, and the majority of them are illustrated. Another feature of the journal are the careful summaries of contemporary geographical, ethnographical and archæological literature. The following titles taken from the current volume (lxxxii.) illustrate the range of subjects:—A historical-ethnological study on gynæcological "ex voto," by Dr. E. Blind, with illustrations (p. 69); Dravidian folk-poetry, by Mr. W. Gallenkamp; dwarfs in history and tradition, by Mr. D. MacRitchie. In the previous volume, there were papers by Mr. G. Thilenius on prehistoric pygmies in Schlesien (p. 273), and by Mr. J. Kollmann on pygmies in Europe and America. Prof. K. Weule raises the question (vol. lxxxii. p. 247) whether there are dwarf people in New Guinea. His remarks are based on photographs of three men whose stature ranged from 1201m. to 1205m. Further evidence must be obtained before we can be sure whether these are a true pygmy people or only dwarfed Papuans. Name-giving and marriage among the Orang Temia of the Malaka Peninsula, by Hrolf Vaughan Stevens, edited by H. Stönner (p. 253). An article by Mr. G. Knosp on the Annamite Theatre is illustrated by a coloured plate. An interesting *résumé* of archæological, somatological and ethnographical researches in Portugal is given on pp. 283–289. Dr. C. Kassner describes and figures (p. 315) various ethnographical survivals in Bulgaria, amongst others the suspended boards that are used as gongs.

In the current number of the *Reliquary and Illustrated Archæologist* is the first of a series of papers on prehistoric Dartmoor, by Mr. R. Burnard, which promises to be a valuable contribution to the archæology of a most interesting region. A few years ago, extremely little was known about the monuments of Dartmoor, but thanks to the labours of the Dartmoor Exploration Committee of the Devon Association for the Advancement of Science, Literature and Art for the past six years, a considerable amount of information has been obtained. The present communication deals with hut-circles.

Designs cut in rocks have previously been recorded from New Caledonia, but M. Archambault in *l'Anthropologie* (xiii., 1902, p. 689), gives a number of photographs of petroglyphs that he has discovered, and certainly many of them are very remarkable, and they open out a promising field for inquiry. Unfortunately, the author was unable to obtain any information from the natives respecting them, but it does not follow that all knowledge about them has passed away, and it is to be hoped that fresh endeavours will be made to elucidate their signification. In the same journal will be found a further paper by M. Ch. de Ujfalvy of his series on the "Iconographie et Anthropologie Irano-Indienne," in which he deals with the physical type of living Hindus, based on the researches of Risley and Crooke. He alludes to Nesfield's view regarding the caste system, and upholds his conclusions in opposition to Risley's adverse criticism.

The French are masters in the art of popularisation of science; to take a recent example, one can buy for 60 centimes a carefully compiled, up-to-date summary of French archæology by Zaborowski ("Bibliothèque utile," F. Alcan, Paris). In the seventh edition of "l'Homme préhistorique," the French people can learn the opinion of specialists on the ancestry of man and the main characteristics of the men of the variou archæological epochs. The tools, weapons, artistic efforts of Palæolithic man are described. The feature of this excellent little book is the prominence paid to the transition period between the Palæolithic and Neolithic periods. The Bronze and Iron ages are merely alluded to.

In the current number of *Man*, the monthly journal o. general anthropology which is published under the direction of the Anthropological Institute, besides several papers on the physical anthropology of different peoples, there are interesting contributions on the use of diagrams for craniometrical purposes. Archæology, mainly Egyptian Mediterranean, is particularly well represented. The arts and crafts of various peoples are described in numerous interesting papers, and comparative religion is well to the fore, the discussions on totemism and on the Supreme Being in Sarawak being more especially noteworthy. The articles and notes in *Man* are written in non-technical language, and as they are of such general interest, the journal deserves to reach a wide circle of readers.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. J. J. DOBBIE, professor of chemistry in University College, North Wales, has been appointed director of the Edinburgh Museum of Science and Art.

ON Thursday, April 2, a meeting will be held in the map room of the Royal Geographical Society, when Prof. Elisee Reclus will speak on the subject of geographical education, with special reference to his globular contoured maps, globes and reliefs, of which he will exhibit examples. All interested in the improvement of cartographical methods are specially invited to attend and take part in the discussion.

FIFTEEN science professors of Calcutta colleges have, it is reported in the *Pioneer Mail*, signed a protest against the proposals of the recent Universities Commission in connection with the teaching of science. Their memorial points out that the principal recommendations of the Commission regarding science teaching tend to discourage instruction in science, for, they continue, the Commission propose to exclude it altogether from entrance examinations, and make it optional for the higher examinations; so that if the recommendations of the Commission are adopted, students will be allowed to obtain the highest degrees of the university without being required to acquire a knowledge of even the rudiments of any branch of science at any stage of their university training. Dr. MacKichau, Vice-Chancellor of the Bombay University, in a speech at Convocation on February 24, proposed that a fund of not less than twenty lakhs of rupees be raised to found a science school in the University of Bombay. Part of this money must, he said, come from the public; Government may be safely trusted to provide the remainder. Part of this fund would be employed to provide buildings for the science laboratories and to equip them with the necessary appliances; part of it in providing instruction by professors appointed by the University, aided by lecturers supplied by the various colleges at its request.

WHAT is known as the "National Diploma in Agriculture" is administered by a joint board elected by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland. This diploma took the

place of one which was originally granted by the Highland Society. Teachers of agricultural science have alleged that the regulations in connection with the national diploma are unsatisfactory, but notwithstanding the attempts of the Agricultural Education Association to secure their improvement, the joint board seems unwilling to alter the conditions of awarding diplomas. Prof. Wallace, of Edinburgh University, enumerates some of the disadvantages attached to the present state of affairs in a recent pamphlet, and among them he mentions that Scottish students have to travel twice to Leeds to be examined by a board from which teachers of agriculture are practically excluded, that the present scheme encourages cramming, and that it is national only in name. Prof. Wallace has obtained the opinion of the Solicitor-General of Scotland as to the position of the Highland Society in relation to its Charter on Education, 1856. This Charter empowers and requires the council of the Highland Society to appoint a board of examiners and to grant diplomas, and the opinion of counsel is that by its action in 1899 in agreeing to the joint board, the council of the Society is not acting in conformity with the provisions of its Charter. Prof. Wallace is, it appears, entitled to take steps to compel the council to proceed in accordance with the Charter.

The following announcements of gifts to higher education in the United States have appeared in *Science* since the beginning of December, 1902:—Mr. James Stillman, 20,000*l*. to Harvard University for the endowment of a professorship in comparative anatomy. Mr. Peabody has offered to the University of Georgia a 10,000*l*. building, provided the Legislature will appropriate to the University for maintenance the sum of 2000*l*. a year for two years, and make improvements costing 240*l*. A bequest of 16,000*l*. was made to Yale University by the will of Mr. Benjamin Barge. Mr. Morris Jesup, 2000*l*. to Princeton University. Mr. John D. Rockefeller, 200,000*l*. to the University of Chicago, to be added to the endowment, and other sums amounting to 105,200*l*. have been given to the same university. Tulane University has been made the residuary legatee of the late Mr. A. C. Hutchinson, and it is expected that it will receive 200,000*l*. The University of Rochester has received 2000*l*. from Mrs. Steele. Yale University will ultimately receive 10,000*l*. for the aid of poor students by the will of the late Mrs. Courrier. Dr. D. K. Pearsons has given to Illinois College, Jacksonville, 10,000*l*.; to Fargo College, Fargo, N. D., 10,000*l*.; to West Virginia Conference Seminary, Buchanan, 10,000*l*.; to Pomona College, at Claremont, 10,000*l*.; and to Fairmount College, Wichita, Kas., 5000*l*. This makes the total of Mr. Pearsons's contributions to colleges 800,000*l*. Mr. Henry Phipps, 60,000*l*. for the establishment in Philadelphia of "The Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis." Cornell College, Iowa, has added 14,300*l*. to its endowment funds. A friend whose name is not yet made public gave 10,000*l*. Mr. Fred W. Brown has given 2000*l*. Harvard University received 10,000*l*. by the will of Rebecca C. Ames, the income to be used for the support of poor students. The University of Pennsylvania received gifts during the year to the value of 187,370*l*. Mr. Robert E. Woodward, 10,000*l*. to the Brooklyn Institute of Arts and Sciences. The Duke de Loubat, 20,000*l*. to Columbia University for the establishment of a chair of American archæology. Oberlin College has received an anonymous gift of 10,000*l*. from the same donor who recently gave 10,000*l*. By the will of the late Prof. Waterhouse, Washington University received 5000*l*., and Harvard University and Dartmouth College each 1000*l*. Mr. S. M. Inman, 5000*l*. toward the proposed Presbyterian university to be erected in Atlanta, Ga. Cornell University has received an anonymous gift of 30,000*l*. for the establishment of a pension fund. Mr. James B. Colgate, 20,000*l*. to Colgate University, Hamilton, N.Y., to which he had already given more than 200,000*l*. Mr. Andrew Carnegie, 20,000*l*. to Western Reserve University for the establishment of a school for the training of librarians. Columbia University received 2000*l*. for the establishment of a scholarship by the will of Mrs. Banker. It thus appears that in three months universities and colleges of the United States have, owing to the liberality of American citizens, benefited to the extent of more than one and a quarter millions sterling.

SCIENTIFIC SERIAL.

Journal of Botany, March.—Under Limonium Mr. E. S. Salmon discusses the varieties and synonyms which Hooker, in his "Student's Flora," places together under *Statice auriculaefolia*.—The fresh-water algæ reviewed by Messrs. W. West and G. S. West are mostly small Chlorophyceæ, and include five new species and a new genus, Polychætophora.—The notes on Myricaceæ contributed by Dr. Rendle were prompted by a rearrangement of the British Museum plants consequent upon Chevalier's recent revision of the group, whereby certain forms are separated from Myrica to form the new genera Gale and Comptonia.—The diagnoses presented by Mr. Spencer Moore refer to new sympetalous plants collected in the Coolgardie district of W. Australia.—The following short articles occur:—"Rubi of the Neighbourhood of London," by Rev. W. M. Rogers; "*Lepidium Smithii*," var., by Mr. F. Townsend; "Possible Use of Essential Oils in Plant Life," by Dr. G. Henderson.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 5.—"The Differential Invariants of a Surface, and their Geometric Significance." By Prof. **Forsyth,** F.R.S.

The present memoir is devoted to the consideration of the differential invariants of a surface; and these are defined as the functions of the fundamental magnitudes of the surface and of quantities connected with curves upon the surface which remain unchanged in value through all changes of the variables of position on it. They belong to the general class of Lie's differential invariants; and some sections of them were obtained about ten years ago by Prof. Zorawski, who, for this purpose, developed a method originally outlined by Lie. Earlier, they had formed the subject of investigations by a number of geometers, among whom Beltrami and Darboux should be mentioned.

Prof. Zorawski's method is used in this memoir. In applying it, a considerable simplification proves to be possible; for it appears that at a certain stage in the solution of the partial differential equations characteristic of the invariance, the equations which then remain unsolved can be transformed so that they become the partial differential equations of the system of concomitants of a set of simultaneous binary forms. The known results of the latter theory can then be used to complete the solution.

The memoir consists of two parts. In the first part, the algebraic expressions of the invariants up to a certain order are explicitly obtained; in the second, their geometric significance is investigated.

An invariant, which involves the fundamental quantities of a surface E, F, G, L, M, N (these determine the surface save as to position and orientation in space) and their derivatives up to order n, as well as the derivatives of functions ϕ, ψ, of position on the surface up to order $n+1$, may itself be said to be of order n. The invariants up to the second order inclusive are obtained. It appears that, if two functions ϕ and ψ occur, all the invariants that occur up to the second order can be expressed algebraically in terms of 29 algebraically independent invariants; while, if only a single function ϕ occurs, all the invariants that occur up to the second order can be expressed in terms of 20 algebraically independent invariants.

The significance of these respective aggregates of 29 and of 20 invariants is obtained in connection with curves

$$\phi = 0, \quad \psi = 0,$$

drawn upon the surface. The investigation reveals new relations among the intrinsic geometric properties of a curve upon a surface. In particular, up to the second order, four such relations exist for a single curve, and their explicit expressions have been constructed.

March 12.—"On the Histology of *Uredo dispersa*, Erikss., and the 'Mycoplasm' Hypothesis." By Prof. H. Marshall **Ward,** F.R.S.

The paper deals with a detailed study of the histological

features of the germination, infection and growth of the mycelium of the Uredo in the tissue of grasses. Primarily, the figures refer especially to the Uredo of *Puccinia dispersa* in the tissues of *Bromus secalinus*, but comparisons are made with the behaviour of this and other Uredineæ—*e.g.* *Puccinia glumarum* and *P. graminis*—in the tissues of other grasses and cereals.

The research, which has been carried on for more than a year and a half, and has involved the preparation and microscopic examination of thousands of sections, is principally based on the application of improved hardening and staining methods to preparations from tube cultures of the grasses concerned, the leaves of which were infected at definite spots. These tube cultures were prepared according to the method previously described.[1] At definite intervals after sowing the spores—*e.g.* after one, two, to six and eight days—the infected areas were removed and placed in fixing solutions, and the life-history of the fungus traced step by step, and controlled by reference to uninfected areas.

The full paper is illustrated by numerous figures, and deals with the behaviour of the nuclei, vacuoles, septa, branches, haustoria, and other details of the hyphæ up to the commencement of spore-formation.

The relations of the hyphæ and haustoria to the cell-contents of the host are critically examined, and the cumulative evidence not only fails to support Eriksson's "Mycoplasm" hypothesis, but is completely subversive of it, so far as histological facts are concerned.

Eriksson's hypothesis, which refers the epidemic outbreaks of rust to the sudden transformation into the mycelial form of a supposed infective substance, previously latent and invisible in the cytoplasm of the host, is shown to be untenable because the *corpuscules spéciaux* of this author are proved to be the cut-off haustoria of the fungus.

Eriksson supposes that these *corpuscules* (haustoria) are formed by the hitherto latent germs in the host-cells, growing up in the cells into vesicles, which then pierce the cell walls and give rise to hyphæ in the intercellular spaces.

The present paper shows that Eriksson has entirely reversed the true order of events. The haustoria have been formed by the hyphæ, and figures are given showing every stage in their development. The first haustorium may be formed by the infecting tube immediately after its penetration through the stoma, and figures are given showing the remains of the germ-tube outside a stoma, the swelling of its tip over the stoma into an appressorium, the passage through the stomatal cavity, and its development into a vesicular swelling whence the true infection tube arises, which latter may at once put forth a haustorium. In some cases all these latter phenomena are visible in one and the same preparation.

The author expresses his thanks to Miss E. Dale, of Girton College, for valuable aid during the later stages of the work, in the embedding and cutting of numerous sections.

"The Œstrous Cycle and the Formation of the Corpus Luteum in the Sheep." By Francis H. A. **Marshall.** Communicated by Prof. J. C. Ewart, F.R.S.

Physical Society, March 13.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—A paper by Dr. **Farr,** on the interpretation of Milne seismograms, was read by Dr. Chree. Prof. Milne and Dr. Omori have come to the conclusion that the tilts represented by the maximum displacement of the boom of a horizontal pendulum seismograph are too large to be admissible as true tilts. The author has investigated the motion of the boom analytically, and his results show: (1) that the boom does not vibrate with its own natural period, but takes the frequency of the disturbing force; (2) that the friction should be small compared with the difference of the squares of the frequencies; and (3) that the phenomenon of beats may occur between the forced vibration and the free period of the boom. The maximum amplitude of swing of the boom gives no information whatever of the amplitude of the disturbing cause without also a knowledge of the periods of the forced and free vibrations. The author shows how to determine the amplitude of the wave by observations on these quantities. The author has verified the results of his analysis by experiments with artificial waves of known periods produced by an apparatus described in the paper. In conclusion, it appears (1) that strict attention should be paid to recording accurately the period of free vibration of the boom; (2) that the tape should be driven at such a speed as to enable the period of forced vibration to be determined; (3) that the effect of friction should be recorded.—A potentiometer for thermocouple measurements was exhibited and described by Dr. **Lehfeldt.** To make a satisfactory potentiometer for thermoelectric work, it is essential that it shall not introduce a high resistance in the circuit of the couple and galvanometer. Most of the potentiometers on the market, well enough for comparing voltaic cells, fail in this respect. Dr. Lehfeldt has therefore designed an instrument specially suited for thermocouple work.—Dr. J. A. **Harker** exhibited and described a direct-reading potentiometer for thermoelectric work. The instrument represents a form which has been designed and made in the National Physical Laboratory. Dr. Harker has experienced similar difficulties to Dr. Lehfeldt, and the instrument which he has designed is similar in many respects to the one exhibited by him.—A paper on the measurement of small resistances was read by Mr. A. **Campbell.** The object of this paper is to give a brief account of a number of measurements of a set of low resistance standards belonging to the National Physical Laboratory. The tests were made partly with a view to comparing various methods of measurement. The resistances were of manganin, and their nominal values were approximately 0·1, 0·01, 0·001 international ohms. The following methods were employed:—(1) Shunt potentiometer; (2) Kelvin bridge; (3) two-step bridge; (4) differential galvanometer; (5) Matthiessen's and Hockin's method. The last method was found to be much less accurate than the other four. The results obtained from the other methods are tabulated in the paper, and show very satisfactory agreement.—Dr. R. A. **Lehfeldt** read a paper on a resistance comparator. Objecting to sliding-contacts on account of the thermoelectric effects they tend to introduce, and irregularities slide-wires show when a good deal used, the author has substituted for the slide-wire two coils of 99 ohms each connected by twenty coils of 0·1 ohm each. The latter are arranged circularly, so that a switch connected to the galvanometer may be set on any one of the intervening studs. The galvanometer deflections are taken for the two positions nearest balance and interpolation to 1/100 calculated. In this way an accuracy of one part in 100,000 is attainable. The author thinks there is a gain of accuracy as well as of convenience in using the interpolation method.

Royal Astronomical Society, March 13.—Prof. H. H. Turner, president, in the chair.—The secretary read a letter from Mr. S. C. **Chandler** directing attention to a new term in the variation of latitude that had been discovered by Mr. Kimura, of the International Latitude Station in Japan. Mr. Chandler had been unable to find any probable explanation for the term, and proposed that, for its investigation, a southern belt of latitude stations should be established, suggesting stations at Sydney, the Cape of Good Hope and Santiago de Chile.—Mr. **Newall** read a paper on observations made at Cambridge of the velocity in the line of sight of certain selected stars, his communication being the first instalment of a work undertaken in accordance with a scheme of cooperation.—A paper by Dr. Max **Wolf** on three of Sir W. Herschel's observed nebulous regions in Orion was read, illustrated by a photograph, including three of the regions described by Sir W. Herschel as nebulous, but in which Dr. Isaac Roberts's photographs had shown no nebulosity. Dr. Wolf's photographs, on the contrary, showed considerable nebulosities. Dr. Roberts criticised Dr. Wolf's results, and read a communication of his own on photographs of various nebulæ, including ten which are new.—Mr. Whittaker gave an account of a communication from Prof. Simon **Newcomb** on the desirability of a reinvestigation of the problems arising from the mean motion of the moon. Prof. Newcomb called attention to the discrepancies between the predicted and observed places of the moon, and showed the comparative failure of attempts hitherto made to explain them. He considered it necessary to reinvestigate the whole question *ab initio*, and suggested a thorough comparison of the tabular and observed places

[1] "On Pure Cultures of a Uredine, *Puccinia dispersa* (Erikss.)" (*Roy. Soc. Proc.*, 1902, vol. lxix. p. 461).

of the moon, to be undertaken by a system of international cooperation. The Astronomer Royal and others took part in the discussion on Prof. Newcomb's paper.—A series of photographs presented by the Yerkes Observatory was shown on the screen. The photographs were taken by Mr. G. W. **Ritchey**, those of the moon with the 40-inch refractor and a colour screen, and those of nebulæ, &c., with the 24-inch reflector.—A paper by Mr. Stanley **Williams** was read on the short period variable star UY Cygni.—Other papers were taken as read.

Anthropological Institute, March 10.—Dr. J. G. Garson in the chair.—(1) Skulls from the Danes' graves, Driffield, Yorkshire; (2) a method to facilitate the recognition of Sergi's skull types, by Dr. William **Wright**. Dr. Wright described twenty-two skulls, fifteen being those of males and seven of females. Nine of these he showed were dolichocephalic, five mesaticephalic, while he was in doubt as to the classification of the remaining eight, owing to their precarious state. The cephalic index ranged from sixty-eight to seventy-nine, and the skulls evidently were those of a mixed race which was on the whole dolichocephalic. According to Sergi's natural method ten of them belonged to the class *Ellipsoides isocampylos*, seven to *Isobathys Siculus*, whilst the remainder were of *Ellipsoides amctopus, Ellipsoides depressus*, and *Parallelepipedoides* types. The graves were of the early Iron age, iron articles being found in them, and the burials being of the usual simple type. As to the origin of the people buried, Dr. Wright suggested two hypotheses: either they were the direct descendants of the dolichocephalic Neolithic British or they were settlers from the Continent. In support of the latter hypothesis, Dr. Wright pointed out that the settlement was very near the coast, and that there were two others close by, at Arras and Beverley. It was clear, from the absence of weapons and the presence of women and children in the interments, that the settlers were peaceful people. On the whole he was inclined to think that the people came from northern Europe and Scandinavia, which at that period were peopled by a comparatively pure dolichocephalic race. In his second paper Dr. Wright explained a method for facilitating the recognition of Sergi's skull types. He said that he felt the great difficulty in Sergi's system was the vague definition of the types. To facilitate the recognition, Dr. Wright draws, on a photograph of the skull, a circle the radius of which is half of the maximum diameter of the skull, when the different types are recognised through different parts of the skull falling either within or without the circle. This method further gives aid to the eye of the observer by providing a uniform curve with which to compare the anterior and posterior outlines of the cranium. Dr. Wright illustrated the system by lantern slides showing the method as applied to the different aspects of the skull.

Royal Meteorological Society, March 18.—Captain D Wilson-Barker, president, in the chair.—Mr. C. V. **Boys**, F.R.S., gave a lecture on the transmission of sound through the atmosphere. He began by contrasting the apparent behaviour of waves of water, sound waves and light waves with respect to physical law, and showed that these were merely an effect of the relative scale of the wave-length and the means of observation. He pointed out the perfection of the behaviour of ripples and very small water waves. There is a difficulty in making experiments with sound with apparatus smaller than houses or hills, unless sound waves so short as to be inaudible are employed. Mr. Boys showed the obedience of sound to the ordinary optical laws. Sound waves may, in special circumstances, become visible. By means of lantern slides the lecturer showed that the air waves in bullet photographs are visible, and animatograph representations were given of the shadow of the sound of a great explosion, and also of Prof. Wood's photographs of the reflection of sound waves. Reference was made to Dr. Rapp's interference observations of sound waves produced by instruments and by the voice. The lecturer explained that light has, in a minor degree, the same kind of imperfection so noticeable with sound. He concluded by referring to mirage and looming in optics, and stated that the corresponding phenomena in acoustics give rise to abnormal audibility of sound.

CAMBRIDGE.

Philosophical Society, February 16.—Mr. Seward, vice-president, in the chair.—On the dynamics of the electric field, by Prof. J. J. **Thomson**, F.R.S. It is shown that all the laws relating to the distribution of momentum in the field follow from the view that the lines of electric force carry along them a portion of the ether through which they pass, the mass of ether entangled with the tubes being per unit volume proportional to the electrostatic energy of the field in that unit volume; the ether thus entangled can slide along the line of electric force, but as far as motion at right angles to the line is concerned, the entangled ether moves with the line of force, the momentum in the electric field is the momentum of the ether gripped by the lines of force. It was suggested that all mechanical momentum and not merely electrical momentum was really momentum of the ether; the molecules of matter containing a number of electrified bodies ("corpuscles"), the lines of force starting from these corpuscles grip a certain amount of the ether and that the mass of the body is really the mass of the ether gripped by the lines of electric force starting from its corpuscles. The potential energy of the field is on this view the kinetic energy of the turbulently moving ether imprisoned by the lines of force.—Rust-fungi and the "mycoplasm" hypothesis, by Prof. H. Marshall **Ward**, F.R.S. The author gave a brief account, illustrated with lantern slides and microscopic preparations, of that part of his researches into the histology of rust-fungi which bears upon the recent pronouncement of Eriksson, that certain *corpuscules spéciaux* observable in the cells of the host-plant are the assumed "mycoplasm" in the act of growing out to form the hyphæ of the fungus. The author's preparations show clearly that Eriksson's *corpuscules* are true haustoria, put forth by the hyphæ of the fungus into the cells of the host. Every stage in their development is traced, and since the entering germ-tube, after swelling up as an infecting vesicle and tube in the stomatal cavity, is found to put forth one of these haustoria at a very early date, the reversed order of the phenomena assumed by Eriksson cannot be accepted.—On radio-activity from snow, by Mr. C. T. R. **Wilson**, F.R.S. An experiment of the same nature as those already made with freshly fallen rain and described before this Society (*Proceedings*, vols. xi., p. 428, and xii., p. 17, 1902) was made with freshly fallen snow at Peebles on January 10. The snow was melted and 50 c.c. of the water were evaporated to dryness in a porcelain basin. This was then inverted over the thin aluminium roof of the ionisation apparatus used as a detector of radio-activity (described in the first of the above-mentioned papers). The results give no indication of any difference in the intensity of the radio-activity obtained from equal weights of snow and rain.—Note on the slipperiness of ice, by Mr. S. **Skinner**. The slipperiness of ice has been attributed to the presence of a layer of lubricating water under the body pressing on the ice. The water is produced by the lowering of the freezing point where the pressure is experienced. On this view the object glides on a liquid layer, and consequently viscous friction in water takes the place of the rubbing friction between the solids. Joly has shown by calculation that the weight of a man concentrated on the blade of a skate is sufficient to lower the freezing point very considerably, and Reynolds, arguing from the difficulty of slipping on very cold ice, comes to the same conclusion. In the present paper it is pointed out that sliding on a liquid layer is a condition under which cavitation will occur in the liquid, and that this will aid the slipping.—On the rise of a spinning top, by Mr. E. G. **Gallop**.—On automorphic functions and the general theory of algebraic curves, by Mr. H. W. **Richmond**.

March 2.—Dr. Baker, president, in the chair.—On the probable presence in the sun of the newly discovered gases of the earth's atmosphere, by Prof. **Liveing**, F.R.S. Stassano recently pointed out that the chromospheric rays measured by Deslandres and Hale correspond closely with rays found to be emitted by the most volatile gases of our atmosphere, and of the 330 chromospheric and coronal rays photographed by Humphreys during the total eclipse of May, 1901, 200 agree within one unit of wave-length with rays either of the more

volatile gases or with rays of krypton, xenon, or argon. Until more exact measures of the wave-lengths are to hand it is not possible to prove coincidence. The author shows that theoretically there must be an interchange of atmospheric gases between sun and planets, that the interplanetary space could not be a vacuum but must contain many millions of molecules per cubic centimetre, and that the interchange would not depend on the number of molecules which would chance to acquire velocity enough to carry them beyond the earth's attraction, but upon diffusion with only the average kinetic energy of the molecules, which takes place with extreme rapidity when the free path is long.—On a synthesis of carboxy-derivatives of pyridine, by Mr. W. J. **Sell**, F.R.S., and Mr. F. W. **Dootson.**—Experiments illustrating new reactions for the identification of urea and of primary amines, by Mr. H. J. H. **Fenton**, F.R.S. These experiments illustrated the application of a certain new derivative of methyl-furfural as a reagent for the identification of certain organic nitrogen compounds.—(1) A rapid method of estimating sugars; (2) selection of seeds by chemical methods, by Mr. T. B. **Wood** and Mr. R. A. **Berry.** Attention was directed to the importance of selecting for seed production, mother plants of superior chemical composition, and to the great improvement brought about in sugar beet, and in certain American wheats, by the systematic application of such methods. A description was given of the first year's work in attempting to apply chemical methods to the selection of mother plants of the mangel, swede and kohl rabi for growing seed.—Methods of preparation of osones, by Mr. R. S. **Morrell.**—Note on the stereochemistry of benzene, by Mr. H. O. **Jones** and Mr. J. **Kewley.** The authors prepared the dextro-camphor-sulphonate (Reychler) and the dextro-bromo-camphor-sulphonate of 1 : 3 : 4-methyl-chloro-amino-benzene and examined their rotatory powers after repeated recrystallisation from non-hydroxylic solvents. Both salts were found to have values for their molecular rotatory power practically identical with those of salts of the respective acids with inactive bases, and the base recovered from the salts was quite inactive. Hence, unless both salts are partially racemic, the benzene compound is incapable of showing optical activity.—A method of detecting nickel and cobalt in presence of each other, by Mr. F. W. **Dootson.** The method depends upon the difference in colour of ethereal solutions of the double thiocyanates of nickel or cobalt and potassium.—On the Joule-Thomson effect, by Mr. P. V. **Bevan.**—On a sensitive gold-leaf electrometer, by Mr. C. T. R. **Wilson**, F.R.S. The electrometer is sufficiently sensitive to give a deflection per volt of 180 scale divisions of the eye-piece micrometer of the reading microscope. The increased sensitiveness has been secured without increasing the capacity of the instrument. It is therefore specially suitable for the measurement of very small quantities of electricity.—A new mineral from the Binnenthal, by Mr. R. H. **Solly.** This mineral belongs to the group of sulpharsenites of lead, and is closely allied to rathite and baumhauerite.

MANCHESTER.

Literary and Philosophical Society, March 3.—Mr. Charles Bailey, president, in the chair.—A paper entitled "Further Investigation of the Detection and Approximate Estimation of Minute Quantities of Arsenic in Malt, Beer and Foodstuffs" was read by Mr. W. **Thomson**, who pointed out that he had greatly improved the process which he had already published, and that by this improved method he had been able to obtain a very distinct mirror of arsenic in beer, for instance, when it existed to the extent of 1/3000 part of a grain per gallon, when working on 50 c.c., which is equivalent to less than a sherry glassful of the beer. This is equivalent to the detection of about one part in two hundred and eighty millions of beer.—Prof. H. B. **Dixon**, F.R.S., exhibited an electrolytic Marsh apparatus for the detection of arsenic, which had been approved by the Government authorities, and he claimed that it was sufficiently delicate for the purpose in view.—Mr. Francis **Jones** referred to the recent observations on the bending of marble made by Prof. See, of Washington, and pointed out that similar phenomena have long been known. Lantern slides were shown of marble tombstones (particularly that of Prof. Black) in Edinburgh churchyards, which have fallen to pieces in the course of sixty or seventy years, the marble in each case having bent outwards.

PARIS.

Academy of Sciences, March 16.—M. Albert Gaudry in the chair.—On the solidification of fluorine and on the combination at $-252^{\circ}\cdot5$ of solid fluorine and liquid hydrogen, by MM. H. **Moissan** and J. **Dewar** (see p. 497).—The heart in a pathological state, by MM. Ch. **Bouchard** and **Balthazard.** It has been shown that the cardiac area, A, is not sufficient to characterise the dimensions of the organ. It is necessary to determine the ratio of this area to a quantity which characterises the individual examined; the magnitude of the ratio S/A, where S is the albumin normally fixed in the tissue, gives figures which are comparable between themselves. This ratio has been determined in seventy-four cases, and the results obtained are tabulated. It was found that in certain pathological states the heart may have its normal dimensions, in others, tuberculous cases being left out of consideration, the ratio may be above the normal, but never below it.—On bacilliform bovine piroplasmosis, by M. A. **Laveran.**—On the effect of temperature on electrocapillary phenomena, by M. **Gouy.** In general, the maximum height observed decreases with a rise of temperature, and for water and certain inorganic salts the temperature coefficient is practically the same. The coefficient is smaller for the organic substances examined.—On the present state of the Soufrière of Guadeloupe, by M. A. **Lacroix.** The volcanic manifestations of Guadeloupe have not changed their nature; the present observations, like all those which have been made since the last eruption in 1837, shows that the activity of the fumerolles undergoes variations in intensity, and also that they are not fixed in position.—On the existence of derived functions, by M. H. **Lebesgue.**—On geodesics of three dimensions, by M. A. **Boulanger.**—On the theory of the tempering of steel, by M. André **Le Chatelier.**—Propagation in conducting media, by M. Marcel **Brillouin.**—On the dielectric cohesion of mixture of gases, by M. **Bouty.** The critical field for a gaseous mixture is intermediate between that of either of the constituent gases, and for gases which do not act chemically on each other the critical field is exactly the mean of the critical fields of the two gases considered separately at the pressure of the mixture.—On the production of induced radio-activity by actinium, by M. A. **Debierne.** The experiments with actinium described show that there exists a new radiation characterised essentially by the property of rendering radio-active, in a temporary manner, the bodies which it strikes.—On the heat given off spontaneously by radium salts, by MM. P. **Curie** and A. **Laborde** (see p. 491).—On the combination of plumbic acid with organic acids, by M. Albert **Colson.** The author has prepared lead tetra-acetate, tetrapropionate and tetrabutyrate by the action of red lead on the corresponding acids.—On the heat of transformation of yellow into red phosphorus, by M. H. **Giran.** The value currently held for this transformation, 19.2 calories, is too great. The application of the Clapyron formula gives a much lower result, about 4 calories, and this has been confirmed experimentally in two ways, by the combustion of the two varieties of phosphorus in the Berthelot bomb, and by the action of bromine.—On collargol, by M. H. **Hanriot.** An examination of the substance sold commercially as collargol showed that it contained 87 per cent. of metallic silver, traces of ammonia and nitric acid, together with an albuminoid material. From the reactions of this substance, the conclusion is drawn that collargol is the soluble salt of an acid, collargolic acid, which is sufficiently strong to displace carbonic acid from carbonates. The fact that silver, or rather a deposit containing silver, is deposited during electrolysis at the positive pole is in accordance with this view.—The action of hot metals on the fatty acids, by M. Al. **Hébert.** The fatty acids, by the action of the more oxidisable metals at a high temperature, are first transformed into ketones, which are then decomposed, giving rise chiefly to carbonic acid, hydrogen and ethylenic hydrocarbons.—The properties of a solution of sodium sulphate, by MM. C. **Marie** and R. **Marquis.** In order to determine whether hydrated sodium sulphate undergoes dehydration in solution on warming, measurements were made of the

solubility of sodium chloride in the solution at varying temperatures. The solubility curve was continuous, hence the authors conclude that there is no reason to suppose that the hydrated salt exists as such in solution.—On a new method of preparation of ammonium chloroplumbate, by MM. A. **Seyewetz** and P. **Trawitz.** Lead chloride is treated with hydrochloric acid and the calculated quantity of ammonium persulphate. The transformation is very rapid, 125 grams of lead chloride being converted into the chloroplumbate in two hours.—Diaminoethylenic compounds of cadmium, by M. Ph. **Barbier.**—On some new derivatives of acylcyanacetic esters, by M. Ch. **Schmitt.**—The methylation and condensation of ethyl glutaconate, by M. E. E. **Blaise.**—On tetraphenylbutanediol and its products of dehydration, by M. Amand **Valeur.** This substance is obtained by the action of phenyl-magnesium bromide upon ethyl succinate.—On the distribution in the organism and the elimination of arsenic given medicinally in the form of sodium methylarsenate, by M. A. **Mounyrat.** The arsenic given as sodium methylarsenate has no tendency to accumulate in the organs, and whatever may be the dose absorbed, only a very minute quantity is retained, this being completely eliminated about the thirtieth day after the ingestion.—On the transformations and the epithelial growths which provoke mechanical lesions of the subcutaneous tissues, by M. Ed. **Retterer.**—The Pteraspis in the Ardennes, by M. Louis **Dollo.**—The reflex augmentation of the biliary secretion by the introduction of acid into the duodeno-jejunum, by M. C. **Fleig.**—On the signification of the Cenomanian layer and the fauna of the Maine du Saint-Laurent near Vaches (Basses-Alpes), by M. Charles **Jacob.**—On the anomalies of gravity in certain unstable regions, by M. F. de Montessus **de Ballore.**—The action of zinc on the microbes of water, by M. F. **Dienert.**—Lesions of the nervous system of the newly-born whose mothers are diseased: the mechanism and its consequences, by MM. A. **Charrin** and A. **Léri.**—Regulating apparatus for the circulation of the blood of the newly-born animal, by M. Edouard **Meyer.**—On the diminution of the intensity of the solar radiation, by M. Henri **Dufour.** A comparison of the solar observations made with the Crova actinometer during the first three months of the present year with the results of preceding years shows a distinct falling off in the radiation. Thus it would appear that there is present in the atmosphere a special absorbent for solar radiation which did not exist in the six preceding years, and it is suggested that this may be fine dust from the recent volcanic eruptions.

DIARY OF SOCIETIES.

THURSDAY, March 26.

Royal Society, at 4.30.—Some Physical Properties of Nickel Carbonyl: Prof. J. Dewar, F.R.S., and H. O. Jones.—The Electrical Conductivity imparted to a Vacuum by Hot Conductors: O. W. Richardson.—An Attempt to Estimate the Relative Amounts of Krypton and of Xenon in Atmospheric Air: Sir William Ramsay, F.R.S.—On a New Series of Lines in the Spectrum of Magnesium: A. Fowler.—An Inquiry into the Variation of Angles Observed in Crystals, especially of Potassium-Alum and Ammonium-Alum: Prof. H. A. Miers, F.R.S.—On the Dependence of the Refractive Index of Gases on Temperature: G. W. Walker.—Solar Prominence and Spot Circulation, 1872–1901: Sir Norman Lockyer F.R.S., and Dr. W. J. S. Lockyer.—On the Evolution of the Proboscidea: Dr. C. W. Andrews.

Institution of Electrical Engineers, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms: M. B. Field.—*Time permitting*:—Divided Multiple Switchboards: an Efficient Telephone System for the World's Capitals: W. Aitken.

FRIDAY, March 27.

Royal Institution, at 9.—The Pearl Fisheries of Ceylon: Prof. W. A. Herdman, F.R.S.

Institution of Civil Engineers, at 8.—The Advantages of Motor-Driven Printing Machines: J. G. V. D. Morgan.

Physical Society, at 5.—Evaluation of the Absolute Zero: Dr. R. A. Lebfeldt.—On Refraction at a Cylindrical Surface: A. Whitwell.

SATURDAY, March 28.

Royal Institution, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY, March 30

Institute of Actuaries, at 5.—The Mortality Experience of the Imperial Forces during the War in South Africa, October 11, 1899, to May 31, 1902: F. Schooling and E. A. Rusher.

TUESDAY, March 31.

Royal Institution, at 5.—Great Problems in Astronomy: Sir Robert Ball, F.R.S.

Society of Arts, at 4.30.—British North Borneo: Henry Walker.

Institution of Civil Engineers, at 8.—American Locomotive Practice: P. J. Cowan.

WEDNESDAY, April 1.

Society of Arts, at 8.—Application of Polyphase Motors to the Electrical Driving of Workshops and Factories: A. C. Eborall.

Society of Public Analysts, at 8.—Recent Advances in the Bacteriological Examination of Water: W. H. Jollyman.—The Ash of British Pharmacopœia Drugs: W. Chattaway and C. G. Moor.

Entomological Society.—Contributions towards the Life History of *Orina (Chrysochloa) tristis* var. *Smaragdina*: Dr T. A. Chapman.

THURSDAY, April 2.

Linnean Society, at 8.—List of Marine Algæ collected at the Maldive and Laccadive Islands by J. Stanley Gardiner: Mrs. Gepp (Ethel S. Barton).—The Comparative Anatomy of Cyatheaceæ and other Ferns: D. T. Gwynne-Vaughan.

Chemical Society, at 8.—On the Absorption Spectra of Nitric Acid in Various States of Concentration: W. N. Hartley.—The Dioximes of Camphorquinone and Other Derivatives of *Iso*nitrosocamphor: M. O. Forster. Salts of a Mercaptoid Isomeric Form of Thioallophanic Acid, and a New Synthesis of Iminocarbaminethioalkyls: A. E. Dixon.—Discoloured Rain: E. G. Clayton.—Derivatives of *o*-Aminobenzophenone and *p*-Aminobenzophenone: F. D. Chattaway.

Royal Geographical Society, at 4.—Geographical Education; with Special Reference to Globular Contoured Maps, Globes and Reliefs: Prof. E. Reclus.

Röntgen Society, at 8.30.—Some Effects produced by Radiations: J. H. Gardiner.

FRIDAY, April 3

Malacological Society, at 8.—Additions to the genus Streptaxis: G. K. Gude.—On a New Species of the genus Xylophaga from the English Coast: E. A. Smith.—Notes on some New or Little Known Members of the Family Dorididæ: Sir Charles Eliot.—On a New Species of Cerastus from near Aden, with a Note on *Otopoma clausum*, Sby.: E. R. Sykes.—Descriptions of Two Supposed New Species of Cyathopoma: H. B. Preston.—On Shells Floating on the Surface of the Sea: August Krogh.

Royal Institution, at 9.—Drops and Surface Tension: Lord Rayleigh.

CONTENTS.

THURSDAY, APRIL 2, 1903.

THE NEW ENCYCLOPÆDIA.

Encyclopaedia Britannica. Vol. xxx. New Volumes. Vol. vi. K—Mor. (London: The *Times* Office, 1902.)

As with its predecessors, the articles of scientific interest in this volume are very numerous and varied. The brief but effective biographies of Kelvin, Langley, Lister and Mendeléeff suggest the width of horizon that belongs to the work, as regarded from the scientific standpoint. The subjects and authors have been chosen with the same discrimination which established the reputation of the original ninth edition; every important article displays the careful workmanship of a special expert. In this particular volume, perhaps by alphabetic accident, all shades of gradation of scientific treatment are exhibited, from established metaphysics by Prof. Case, through a short article by Boltzmann on models with a tendency towards metaphysical considerations, to the technical treatment of such subjects as lighthouses, by Mr. W. T. Douglass; machine guns, by Major Barlow; military kites, by Major Baden-Powell; lead, by Mr. H. O. Hofman; mercury, by Mr. S. B. Christy; and mining, by Prof. C. le Neve Foster. Of the facilities which the publishers have afforded for taking advantage of most recent information, the inclusion of a brief account of the eruptions of 1902 under Martinique is sufficient evidence.

The authorship of the articles, in accordance with the traditions of the "Encyclopædia," is made conspicuous by the system of veiled anonymity which consists in putting initials at the end of the article, and thereby setting the reader a little sum in guess work with the assistance of a list of authors of the chief articles at the beginning, and a key to the system of initials at the end. The delicate challenge which this ingenious system offers is one which no self-respecting reader can resist.

We may turn first to the articles which illustrate recent progress in the department of physics and physical chemistry. An article on light, by Dr. C. G. Knott, supplements articles in the original volumes, and deals with photometry and refraction, as well as magnetic rotation, a subject which is subsequently treated in a special article on magneto-optics appearing over the suggestive initials of J. J. T. A brief but very luminous article on lubrication and its relation to viscosity and Tower's experiments is from the pen of Prof. Osborne Reynolds. Metallography and metallurgy, by the late Sir W. C. Roberts-Austen, give an indication of the wide field of research that is opening out in that direction, while Prof. Dewar gives an account of another subject of absorbing interest under the paradoxical heading of liquid gases, in which the general subject of low temperature research is treated from the point of view of most ample scientific experience. Mr. Marconi's name does not appear in the type of the heading of an article, but a concise and effective article by Prof. Fleming on "measuring instruments—electric" makes one feel that perhaps the omission of the subject only arises from the fact that it may be more effectively treated under a later letter of the alphabet. The immense developments of electromagnetics, nominally of magnetism, since Prof. Chrystal's article was written have afforded Dr. Shelford Bidwell an opportunity of which he has availed himself with conspicuous success.

A special welcome should be given to Prof. Henrici's article on mathematical instruments. It is a subject which, in a way, is everybody's business, and perhaps on that account is not generally treated in mathematical or physical text-books. It is one of the advantages of an encyclopædia that information upon such a subject can be put satisfactorily before a reader in a short article by an acknowledged expert.

Turning to the subjects included under cosmical and terrestrial physics, we may notice in passing an article on maps, by Mr. Ravenstein, which includes some interesting historical particulars, and one on limnology, by Dr. H. R. Mill. Prof. Simon Newcomb deals briefly with the work of Profs. Hill and E. W. Brown in an article on the moon. But the two chief articles in this division of the sciences are that on terrestrial magnetism, by Dr. Chree, and that on meteorology, by Prof. Cleveland Abbé. Dr. Chree gives a careful and concise account of recent work on terrestrial magnetism, including the systematic classification and representation of the variations shown by self-recording instruments, and the generalisations arrived at regarding them. He deals also with recent magnetic surveys and the identification of localities of special disturbance, and finally he treats of the evaluation of the Gaussian constants and other representations of the general magnetic conditions of the earth.

The article on meteorology, by Prof. C. Abbé, is specially interesting, as it starts *de novo*, without reference to the original article in the ninth edition, and in thirty-two pages gives a general conspectus of the subject. We may be permitted to consider this article somewhat more in detail later on.

The biological articles include Mollusca, by Mr. Pelseneer; Mammalia, by Mr. Lydekker; Malacostrata, by Mr. Stebbing; and a short unsigned article on malaria, a subject to which one naturally turns with interest in view of recent developments. The present position of the science of medicine is entrusted to the competent hands of Prof. Clifford Allbutt.

Returning to Prof. Cleveland Abbé's article on meteorology, its main headings are (1) fundamental physical data; (2) apparatus and methods; (3) climatology; (4) physical and theoretical meteorology, with an unnumbered addendum on meteorological organisations. The work is what may be expected from a learned and experienced worker in meteorology, although the task of making a rapid survey of the whole range of a very wide subject in a comparatively short article is evidently a difficult one; the difficulty lies partly in the selection of the class of readers to whom the remarks may be supposed to be addressed. In this case the article will certainly be read by meteorologists with great interest and with the wish to go into further details which any brief survey ought to stimulate. To cite an instance of what may be re-

garded as rather exaggerated compression, we may quote a sentence that disposes of the performance of the Campbell-Stokes sunshine recorder, in common use in this country:—

"A sheet of pasteboard or a block of wood at the rear receives the record, and the extent of the charring gives a crude measure of the percentage of full or strong sunshine."

Without further details one cannot help feeling that if the crudeness were entirely in the record, it would never have attached to it the name of the great philosopher about whose work the word "fastidious" seems, if anything, more appropriate than "crude." Again, the system of photographic recording adopted in this country for the barometer and thermometer is dismissed in an equally curt manner as not being "quite adequate to present needs"; it is difficult to see how the "needs" have changed since 1867, when the aspirations of meteorologists were described in words which might be adopted without change to-day.

A similar brevity runs through the whole article. Take, for example, an account of cirrus clouds:—

"They may be formed by mixture or even sometimes by mere contact and the conduction of their own heat to neighbouring cold air. More frequently they must be due to cooling of moist streaks in the atmosphere by expansion and radiation."

If one only really knew whether this is true or not, what should we not know about meteorology? It may be remarked, by the way, that in dealing with the thermal expansion of gases, there is a superfluity of zeros which would alter the whole face of nature if they could not be satisfactorily accounted for by the usual vagaries of the printer.

The article may be described without much exaggeration as a view of the present state of meteorology as seen from Washington. It is a great advantage to have a compendious view of so wide a subject from that most active centre, and from so competent a pen as Prof. Abbé's. No one need complain because the treatment is necessarily somewhat eclectic.

The section on climatology is devoted mainly to rainfall and the generalisations based on rainfall data from all parts of the world. The section on physical and theoretical meteorology is an especially valuable summary, including the most modern developments of the application of dynamical, thermodynamical and electrical theory. The final section, on meteorological organisations, leads, as all such considerations must lead, to the expression of the need for meteorological laboratories in important universities, following in this respect the analogy of the sister science of astronomy.

The reader with scientific tastes is not recommended to follow the reviewer in a rapid survey of the subjects of scientific interest in this volume. If he does so, he can hardly fail to be reminded of those public occasions on which it is felt necessary to give to as many distinguished persons as possible an opportunity, however short, of saying a few words. When the ingenuous reader feels a little at a loss to know why a particular title is selected as the subject of an article in an encyclopædia, the initials at the end may be relied upon to suggest a sufficient reason.

The tendency to represent authors is, perhaps, more conspicuous in this volume than in the ninth edition. An inquisitive person might even find himself wondering whether the term Britannica does not require some adjustment.

THE GEOLOGY OF CENTRAL BORNEO.

Geological Explorations in Central Borneo (1893-94). By Dr. G. A. F. Molengraaff. English Revised Edition, with an Appendix on Fossil Radiolaria of Central Borneo by Dr. G. J. Hinde. Pp. xx + 530 + 56; with 89 illustrations in the text, 56 plates, 3 maps, and a folio atlas of 22 geological maps. (Leyden: E. J. Brill; Amsterdam: H. Gerlings; Sold in London by Kegan Paul, Trench, Trübner and Co., Ltd., 1902.) Price 2*l.* 12*s.* 6*d.* net.

THE Dutch edition of this work appeared in 1899, and Dr. Hinde's appendix, then issued in English, is now transferred, with its separate pagination, to the translation of the complete work. The Borneo Expedition, of which Dr. Molengraaff was the geological member, was organised by Mr. S. W. Tromp, Resident of West Borneo, in connection with the Society for the Promotion of the Scientific Exploration of the Dutch Colonies. The observations were made some ten years ago, and the author has not included references to the work of others, published since the completion of the Dutch edition. We are in possession, however, of the summary of the geology of Borneo drawn up by Dr. E. Suess in 1901 ("Das Antlitz der Erde," 3ter. Band, pp. 308-319), and many readers have already turned to that summary for an exposition of the work of Molengraaff. Dr. Posewitz, about 1890, brought together, after three years' residence in the island, the facts then known about the geology and mineralogy of Borneo ("Borneo"; translated by Hatch, 1892), and his geological sketch-map was intended to show how large a part of the country had already been examined in a preliminary kind of way. Dr. Molengraaff, in his atlas, provides only one geological map, dealing with the parts of Central and South Borneo known to him; an enlarged map of a portion of this area follows, and the other maps prudently record the observations actually made on the banks of the rivers, which provide practically the only routes for travellers in the country. Some generalised sections and panoramic landscapes follow, the latter proving that wide views are obtainable when observers climb above the forest-zone. The fine illustrations and plates in the volume of text reveal, moreover, many features of crag and mountain that will be new to those who think of Borneo as clothed with vegetation, amid which the rivers wander in equatorial shade.

The province of West Borneo, with which the author mainly deals, is practically the basin of the Kapoewas (the River Kapuas of Posewitz). By following it eastward, across a wooded region, where the projections of antique Borneo rise like islands above the vast alluvium, the traveller reaches Sintang, 2600 km. in a straight line from the coast. Here Dr. Molengraaff's

serious work began. He starts at once (p. 19) with the interesting observation that the coarse auriferous gravels near Sintang show that the carrying power of the rivers was formerly greater; and the explanation is found in the greater height of the ranges of the interior in late Cainozoic times. The author returns to these deposits in his valuable geological summary (pp. 453-9), where he states his conclusion that Borneo has undergone continuous degradation, through atmospheric action, in the Quaternary era. The products of decay have encroached on what was in earlier times a shallow sea, broadening the land, and connecting island after island with the central mass by new deposits of alluvium. At the same time, the alluvium has accumulated on the decaying ranges, burying their lower slopes in material which they themselves supplied. In opposition to the elevation-theory of Posewitz, Molengraaff sees in the growth of the river-deposits the real cause of the post-Pliocene extension of Borneo.

From Sĕmitau, higher up the Kapoewas, the author diverged through the thick forest, up a side-stream to Mount Kĕnĕpai. This is a steep mass 1136 m. above the sea, carved out of granite injected by andesite, the granite (p. 432) being of post-Jurassic age. Still more interesting igneous features are seen in the next range visited, on the Mandai River, where huge horizontal beds of volcanic tuff give rise to "table-mountains" bounded by vertical rock-walls. Molengraaff (p. 65) names this range the Müller Mountains, after the murdered explorer Georg Müller, who is believed to have penetrated the area. The volcanic action that here poured out rhyolite and andesite and abundant tuffs along an east-and-west line in Central Borneo was probably post-Cretaceous (p. 441), and may have continued throughout Cainozoic times. The range is now known to extend over at least 280 km., and has doubtless (p. 445) an important relation to the post-Cretaceous movements of the land. Have we here, indeed, unexpectedly revealed by Molengraaff, one of those volcanic chains that accompany the Eurasian "Alpine" system of folding? The author shows how the Müller Mountains have been piled on sunken land (p. 445), which has been lowered by east-and-west faults from the south flank of the Upper Kapoewas range. This old range, the slates of which are possibly of Palæozoic age, was at one time covered by Jurassic rocks, the age of the latter being determined by Dr. Hinde's observations on the radiolaria. These rocks, now preserved by the downward faulting in the lake-district north of Sĕmitau (pp. 123 and 414), are grouped by Molengraaff as the "Danau formation." The faulting has affected the "Eogene" sandstone strata, which once spread across the folded Cretaceous and Danau systems, and terminated somewhere on the flanks of the Upper Kapoewas chain. The plain of the Upper Kapoewas River was thus determined by the downthrow of the Danau beds in Middle Cainozoic times, whereby the chain of mountains to the north was more than ever emphasised. While intrusions of granite had already (p. 449) accompanied the post-Jurassic and pre-Eocene movements, the volcanic line of the Müller Mountains made its appearance along one of the Middle Cainozoic faults. In the eyes of Suess ("Antlitz," Bd. iii., pp. 312, 315, and Tafel xi.), the Upper Kapoewas range forms part of a great bow extending southward from the Philippines, and the volcanoes have arisen on the faulted outer side.

The association of radiolarian cherts with diabase and diabase-tuff, as described so often by the author, seems almost inevitable, although the beds in Borneo are of Jurassic or early Cretaceous age. Mr. J. J. H. Teall has discussed this phenomenon; and it seems independent of geological age. One is reminded of Anglesey, where Mr. Greenly (*Quart. Journ. Geol. Soc.*, 1902, p. 433) has been led to consider the cherts as of organic origin, on account of their association with "pillowy diabase"—so firmly has the connection of these two types of rock, however improbable at first sight, become established in recent years as an article of geological belief.

We must merely mention the interesting ascent of Mount Kĕlam, a strangely smooth boss of pre-Cretaceous micrograniti c rock, the surface of which (p. 138) peels off like the layers of an onion, as in the instances studied by Branner in Brazil. It soon becomes clear to the reader that Central Borneo is rich in a variety of mountain-forms. While Dr. Molengraaff's landscapes will interest the geographer and the artist, other illustrations are of ethnographical value. The chapter on river-curves (p. 473) introduces a new term, "pintas," the Dyak name for a natural short-cut formed across the loop of a meandering stream. Unfortunately it has no convenient European plural, or it might be of much service in geography.

Dr. Hinde's important appendix is already known to palæontologists. The English in the translated part of the volume is, as a whole, clear and carefully printed. The two misprints in the title of plate lii. should, however, have been avoided, but are more than balanced by the action of the English binders, who have curtailed the author's name on the exterior of both the volumes. Dr. Molengraaff has added so much to our knowledge of a difficult country, especially in regard to its tectonic history, that we trust that political disturbances have not removed him permanently from another field of observation, where his work was only just begun.

Grenville A. J. Cole.

PROCEEDINGS OF THE GERMAN ZOOLOGICAL SOCIETY.

Verhandlungen der deutschen zoologischen Gesellschaft, xii. Versammlung, Giessen, 1902. Pp. iv + 221. (Leipzig: Engelmann, 1902.)

The German Zoological Society consists of about 240 experts, who meet in variable numbers for two or three days annually in some happily chosen hospitable spot, where they hold high discourse. There were only about sixty members present at last summer's (twelfth) meeting in Giessen, but the Society, if not large in numbers, is strong in quality. It is not pecuniarily rich, for it has backed out of more than an honorary responsibility with regard to one of its offspring—an expensive child—"Das Tierreich," which the Berlin Academy of Science will henceforth solely foster, but it is rich in enthusiasm, as we infer

from the proposal to segregate into entomological, ornithological and other sections. Long may it live and thrive, and continue to publish its interesting proceedings, which we have just been enjoying. The volume, ably edited by Prof. Korschelt, contains a general introductory address by Prof. Chun; a welcome from Prof. Hansen, as rector of the University of Giessen; a short reminiscence, by Prof. Spengel, of the zoologists who have taught and wrought at Giessen, *e.g.* Leuckart, Schneider and Ludwig; and about sixteen papers, most of which impress us with their general interest, their lucidity and their brevity.

We may arrange the papers in groups:—(1) *Œcological.* Prof. A. Brauer gives an account of the so-called "telescopic" eyes of some deep-sea fishes from the *Valdivia* collection. These eyes tend to be tubular, with wide pupil, reduced iris and very convex cornea. They show a dimorphic retina, the main part at the back of the eye being very different from the accessory part ("Nebenretina"), which is usually medio-dorsal, near the lens, and perhaps adapted for the perception of more distant objects. Brauer notes that the adaptations of the eye in these deep-sea fishes are all of the plus and minus order; the eye is a very conservative organ as regards essential architecture. Prof. J. Vosseler gives an account of the protective adaptations of North African Orthoptera, paying particular attention to the odoriferous vesicle beneath the pronotum of *Œdaleus nigrofasciatus* and *Œ. senegalensis*, and to the blood-spraying apparatus between coxa and trochanter on the legs of the Hetrodid *Eugaster guyoni.* Dr. L. Reh discusses the importance of zoological study in regard to plant-protection. In a profoundly interesting paper, E. Wasmann describes the various adaptations (mimetic, symphilous, &c.) of the Staphylinid guests of Doryline ants, the striking convergence between some Neotropical and some Ethiopian myrmecophils, the particular case of *Mimeciton* to which he awards, as he well may, "the palm of mimicry," and the very suggestive occurrence of what he calls *exaggerated mimicry.* In another paper, the same author shows that the habit of rearing larvæ of Lomechusids (especially of *Lomechusa strumosa*) is responsible for bringing about that strange phenomenon of inhibited female development (the thorax of a female combined with the abdomen and size of a worker) called *pseudogyny.*

(2) *Morphological.*—Prof. C. Chun has traced the development of the chromatophore of the octopus Bolitæna from a small mononucleate cell, through stages with 2, 4, 8, 16, 32 nuclei. There is a large peculiar nucleus in the centre of the pigmented mass; the other smaller nuclei lie peripherally at the bases of the contractile processes. The accompanying figures are very striking. Prof. F. Vosseler finds that an intestinal villus may have a slit-like apical *aperture,* and sometimes a more lateral one in addition. The stroma of the apical region is sometimes cleanly retracted from the enveloping epithelium, so that a cap-shaped space is left with some *débris* and leucocytes. Prof. R. Hesse shows that the truly optic, rod-possessing cells of the Gasteropod retina may be with or without pigment; sometimes the optic cells are pigmented while the indifferent cells are pigmented; sometimes the converse occurs; and in the "Nebenretina" of Limax there is no pigment at all. Gräfin M. von Linden describes in the pupa of *Papilio podalirius* fine projecting hairs, connected through the chitinous sheath, with nerve terminations lying *outside* the epithelium of the body, which again are connected with sub-epithelial nerve strands.

Dr. B. Wandolleck figures the *two-jointed* styles of the female of *Lagria hirta,* thus answering Verhoeff's objection that styles cannot be truly appendicular because always unjointed. Prof. C. B. Klunzinger describes *Ptychodera erythraea,* Spengel, an interesting Enteropneust from the Red Sea, with very large genital flanges (Flügel). Dr. J. Meisenheimer notes the resemblances between the early development of *Ammothea echinata* and that of many Entomostraca, and also the resemblances between the "protonymphon" larva and the nauplius. He concludes that the relationship between Pantopoda and Crustacea is much closer than Dohrn would admit. Dr. F. Schmitt describes the gastrulation of double embryonic primordia in the blastoderm of the trout, and shows that the duplicity cannot be interpreted on the concrescence theory without accessory hypotheses.

(3) *Physiological.*—Dr. H. Jordan's experiments on Astacus confirm the conclusion that the mid-gut gland, besides secreting digestive juices, has a very important absorptive function. It is physiologically, as well as embryologically, just an evagination of the mid-gut.

(4) *Ætiological.*—Prof. W. J. Palacký revolts from the zoogeographical regions of Sclater and Wallace, and maintains that the useful task now is to take class by class, and to correlate present distribution with all that geology has to tell us of the past. Prof. H. Simroth has a remarkable paper in which he applies the "pendulation theory" to the problems of biogeography. In another paper Simroth excels himself in bold speculation, but we are quite unable to follow his elliptical argument, which, as might have been expected from the ingenious author of "Die Entstehung der Landtiere," is a glorification of the evolutionary advantages of *terra firma.* He seeks to show that everything worth having, *e.g.* a head and a vertebrated body, and striped muscles and sexual reproduction, must have been evolved on land. He seems to derive the Sponges from terricolous Acœla, and these form Infusorians, and so on until we land in Probacteria and the organic matter which preceded life. It reads like a recrudescence of "Naturphilosophie."

J. Arthur Thomson.

ANCIENT AND MODERN ENGINEERING.

Ancient and Modern Engineering and the Isthmian Canal. By Prof. William H. Burr. Pp. xv+473. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1902.) Price 14*s.* 6*d.* net.

THIS is an English edition of a book published in America, and contains the outcome of six lectures delivered at the Cooper Union in New York, under the auspices of Columbia University. The first part deals

with ancient civil engineering works, and the remaining parts relate to bridge construction, waterworks for cities and towns, railroad engineering, and the Nicaragua and Panama routes for a ship canal. In the parts relating to modern engineering, the practice and examples described are those followed in America, therefore for English engineers Prof. Vernon Harcourt's book on "Civil Engineering as Applied in Construction," recently reviewed in Nature, which includes the subjects dealt with in the book now under notice, would be found of more service.

The first part, relating to ancient civil engineering, contains a great deal of interesting information, but not of a specially original character. The author points out that the science and profession of engineering dates from very early times, and that many large works that would reflect credit on engineers of the present day were executed in the very dawn of history. The anciently populous country at the head of the Persian Gulf was irrigated and made prosperous by a complete system of canals and irrigation works carried out in the remote past, and traces of hydraulic works, including dams and regulating appliances, are to be found spread over a large territory in the vicinity of Babylon. From the remains still existing, it is calculated that some of these canals must have been from 25 to 30 feet in depth. It is recorded that Alexander the Great, when marching through the Assyrian country, found the River Tigris obstructed by masonry dams constructed for irrigation purposes. The present Suez Canal was preceded between 3000 and 4000 years ago by a channel cut to connect the Red Sea and the Nile. The extensive hydraulic works for regulating the supply of water from the Nile, some of which were carried out seventy centuries ago, involved engineering work of such magnitude as almost to put the great dam at Assuan recently constructed in the shade.

The immense blocks of stone used in the construction of the pyramids and temples and for obelisks show that a knowledge of mechanics must have been well developed in very early times. The remains of many of the ancient buildings afford evidence that both round and pointed arches were made use of. Later on the Romans excelled as engineers, whether as bridge builders, road makers, or in works required for sanitation. The Appian Way, constructed more than two thousand years ago, is only one example of the roads constructed by the Romans, both in Italy and in the lands they conquered, the remains of many of which are to be found at the present day. This road was 350 miles long, and formed a perfect highway between Rome and Brundusium. Water supply was another matter in which the Roman engineers excelled, some of the aqueducts along which the water was conveyed for the supply of their towns extending to a length of from 40 to 60 miles. The streets of Rome were provided with a complete system of sewers, and building laws were enacted for regulating the thickness of the walls and height of buildings, and the quality of the materials of which they were composed. The harbours at Ostia and those at Tyre and Sidon testify to the knowledge of the ancients in this department of engineering, and there are bridges still in existence the foundations of which were laid two thousand years ago.

With regard to the two Isthmian canals, the author sums up their respective capabilities as follows. He considers both routes feasible and practicable; that neither route has any commercial advantage over the other; the harbour features may be made adequate for either canal; the time that will be required for completion is about the same in either case; the control of the water supply will be simpler in the case of Panama; the relative seismic conditions in neither case are of sufficient gravity to cause anxiety; the question of cost is in favour of Panama.

OUR BOOK SHELF.

An Account of the Indian Triaxonia, collected by the Royal Indian Marine Survey Ship "Investigator." By Franz Eilhard Schulze. The German Original translated into English by R. von Lendenfeld. (Calcutta: By Order of the Trustees of the Indian Museum, 1902.)

This admirable report, the latest of the *Investigator* series, deals with 120 examples of Triaxonid Sponges dredged between the years 1885-1890, and it is in reality a revised edition of three memoirs contributed by Prof. Schulze during the years 1894-1900 to the *Abhandl.* Kais. Preuss. Akad., now put into form for translation into English, as modified in respect to important redeterminations arrived at in the study of the *Albatross* collection, and under the influence of contemporary research.

A main distinction is drawn between the Amphidiscophora and the Hexasterophora, the former embracing a description of the Hyalonematidæ (four genera, fifteen species described), the latter of the Euplectellidæ (five genera, eight species), Rossellidæ (three genera, three species), Farreidæ (one genus, one species), and Melittionidæ (one genus, three species). Then follow three tables, of which the first gives a list of the Indoceanic Triaxonia known independently of the *Investigator*, the second a list of the *Investigator* series, of which there were thirty-one species, eight of them from depths exceeding 1500 fathoms, the third a full classification of the known forms, with stations and localities, twenty-four genera and fifty-four species in all, including records of genera and species of the Asconematidæ, Euretidæ, Coscinoporidæ and Maeandrospongidæ of the *Challenger* and *Pola* expeditions.

There are twenty-three magnificent plates, and the forms most noteworthy are *Hyalonema masoni*, in which the Palythoa crust is replaced by Cirripedes; *Saccocalyx pedunculata*, now removed from the Asconematidæ to the Euplectellidæ; *Lophocalyx spinosa*, remarkable for the possession of "silica pearl" spicules; and *Lophophysema inflatum*, a much modified Hyalonematid obtained by the *Investigator* in the Andaman Sea at 498 fathoms, bearing an annular ridge, which sharply subdivides the body into an upper cylindrical portion and a lower conical one, characterised by the presence of large irregular cavities belonging to the inhalant system.

We congratulate Dr. Alcock and the Trustees of the Indian Museum upon this valuable addition to their reports, which rank high in the literature of marine zoology.

The Ventilation, Heating, and Management of Churches and Public Buildings. By J. W. Thomas. Pp. vi + 140. (London: Longmans and Co., 1903.) Price 2*s.* 6*d.*

This book is addressed chiefly to the architects, managers and caretakers of buildings, and its opening chapter deals with the physical principles bearing on ventilation. An interesting account is given of the author's observations on alternating air currents and their effects. Some passages are, however, very obscure, as, for instance, when one reads of "the electrical conditions due to the sudden expansion of the air."

In discussing the effects of wind on ventilation, in the second chapter, the writer makes the cryptic statement that "the friction caused by the wind passing over buildings is so great that it is scarcely possible to demonstrate it accurately," and later on he speaks of the air in a room as being strained "to its utmost limit of tension." The next chapter is on the effects of moist air on ventilation, and here the author reaches a climax. In it we read of "rooms where persons are gathered who evolve sputae or other germs of infectious disease," and we are told that "when air is supersaturated with moisture it become heavier." It is a great pity that any writer should have so little sense of the responsibility of authorship as these extracts indicate.

The next chapter, dealing with air inlets and outlets, is disfigured by an obscure passage about carbonic acid being "held in suspension in a semi-dissolved condition" in air saturated with moisture. The actual state of the ventilation in typical buildings, and the methods to be employed in order to improve matters, are next treated. These portions will be found interesting and suggestive.

The remainder of the book is occupied by the discussion of different methods of ventilation, the ventilation of new buildings, and instructions for caretakers.

J. H. V.

Practical Exercises in Heat. By E. S. A. Robson, M.Sc. Pp. xii + 187. (London: Macmillan and Co., Ltd., 1902.) Price 2*s.* 6*d.*

This useful little volume contains a description of one hundred and two experiments in heat, suitable for an ordinary laboratory course. It is divided into fourteen chapters, each of which comprises a set of classified and numbered experiments—an arrangement which should find favour with teachers of practical physics. At the end of each chapter is given a number of additional experimental exercises, mostly selected from examination papers of the London University. The descriptions are clear and concise, and the text is amply illustrated; the more elaborate experimental corrections are avoided, so as to allow the student to obtain a firm grasp of fundamental principles. The student who conscientiously works through this course should gain fairly accurate results, and, what is more important, a good general idea of the methods of experimental research. The first two chapters are devoted to measurements of temperature, and corrections of the mercury thermometer; these are followed by chapters on the expansion of solids and liquids. It may be noted, in passing, that, in experiment 22, p. 36, on the determination of the temperature at which water acquires its maximum density, the mercury placed in the bulb for the purpose of eliminating the expansion of the latter should have a volume equal to one-seventh of the internal volume of the bulb, not, as is stated, one-seventh of the volume of the glass composing the bulb. The expansion of gases, calorimetry, and change of state are treated in subsequent chapters. Chapters are devoted to electrical methods of measuring temperature, conduction, and radiation. The last chapter is occupied by experiments relating to elementary thermodynamics, including the ratio of the specific heats of air and the value of J. It may be remarked that, though a rough determination of J may be effected by allowing lead shot to fall a number of times down a cardboard tube, and observing the rise of temperature produced, yet if mercury is substituted for the shot, as suggested on p. 155, no appreciable rise of temperature will be obtained, owing to the small viscosity of the mercury. In later editions, it is to be hoped that an account of Prof. Callendar's recently devised method of determining J will be described, since this is the only satisfactory determination which has so far been brought within the reach of the student who can spend but a limited time over an experiment.

E. E.

"The Amateur Photographer" Library. Nos. 25 and 26. *Enlargements: their Production and Finish* (No. 25). By G. Rodwell Smith. Pp. xxiii + 130. Price 1*s.* *Bromide Printing* (No. 26). By Rev. F. C. Lambert, M.A. Pp. xxiii + 74. Price 1*s.* (London: Hazell, Watson and Viney, Ltd., 1902.)

There is no doubt that the photographer is well supplied with literature on his subject, and, as a rule, he is not loth to take advantage of this source of information, although he has to look about him for the book containing the particular kind of help he requires. There are, however, so many workers who do bromide contact printing and enlarge their negatives that these two small manuals on these special topics should prove of great service. The authors treat each manipulation separately, and explain them so that the amateur can easily follow the instructions. One excellent feature of both these books is that the illustrations, which are numerous, exhibit various types of under, correct and over-exposured prints or enlargements, prints from suitable and unsuitable negatives for enlarging, untouched and retouched prints, &c., which should aid the beginner in forming an early judgment on his own results. In addition to the actual routine of the manipulations required, many miscellaneous hints are given, such as obtaining a bromide print quickly from a wet negative, converting a bromide print into a line drawing, &c. Altogether, these manuals are well suited to acquaint amateurs with the nature and use of the materials employed in these processes.

Natural Law in Terrestrial Phenomena. By Wm. Digby, C.I.E., F.S.S., &c. Pp. xlv + 370. (London: W. Hutchinson & Co., 1902.) Price 6*s.*

This book deals with the theory, revived and amplified by Mr. Hugh Clements, which seeks the cause of all meteorological and of most volcanic phenomena in luni-solar attractions. The evidence which Mr. Digby adduces in support of Mr. Clements's theory is not convincing. In the early chapters, he shows how a number of gales and eruptions, more particularly the recent catastrophes in the West Indies, have occurred at times when the astronomical conditions were favourable to the production of high tides, but the important question of how often either of these two sets of phenomena may have occurred independently of the other is not discussed. The chapters on forecasting will probably attract most attention. Mr. Clements tells us that the earth, moon and sun occupy the same relative positions every 186 years, and that, therefore, identical weather conditions will prevail. Given trustworthy records extending over 186 years, forecasting becomes a mere matter of looking up records for corresponding days. Failing such records, we must compare days on which the astronomical conditions are as nearly alike as possible. In appendix iii., rules are given for allowing for the effect of small differences in the parallax, declination and times of transit of the sun and moon, on the height of the barometer, the

determining factor in the weather at any place. The unfailing agreement shown by these calculations arouses suspicion. On closer examination, we find that the signs of the corrections vary quite arbitrarily, while at least five different methods of correcting for declination occur in the text. Results based on such foundations cannot inspire much confidence, even though a fair agreement between predictions and Greenwich records is claimed. The more obvious method of exhibiting the similarity of meteorological conditions under similar astronomical conditions by comparing the corresponding isobaric charts does not appear to have occurred to Mr. Clements. We commend this method to the attention of those who have leisure to devote to a detailed examination of a mode of dealing with meteorology that recurs from time to time.

Bis an's Ende der Welt! Astronomische Causerien. Third Edition. Pp. 212. By Prof. F. J. Studnička. (Prague: Published by the Author, 1903.)

This book, which was dedicated to the celebration of Christian Doppler's hundredth birthday, has reached a third edition. It is written in the form of a conversation among men of various professions meeting socially together every day with the intention of conveying in popular language many astronomical ideas. "To the end of the Universe" is the subject of a dream which one of the members of this convivial party, Carpenter by name and astronomer by profession, had dreamt, and the narrative is his account of this dream to his companions, subject, of course, to many interruptions by one or other of them seeking more information or more detailed explanation.

The author has quite succeeded in his object, and the book will be found to contain an admirable exposition of some of the more general astronomical topics. Being printed in large and Roman type, it should find many readers in this country.

Die radioactiven Stoffe nach dem gegenwärtigen Stande der wissenschaftlichen Erkenntnis. By Karl Hofmann. Pp. 54. (Leipzig: Ambrosius Barth, 1903.) Price 1.60 marks.

This book contains a concise account of the discovery and subsequent investigation of the radio-active elements by Becquerel, the Curies, Rutherford and others. It is written mainly from a chemical standpoint, and many of the effects which have been accurately measured, especially by Rutherford, are referred to as though they had been merely observed and not measured. For example, Rutherford has shown that the radio-activity of thorium-X dies away with time according to the formula e^{-kt}, where t is the time and k a constant, but Hofmann merely mentions that the activity dies away. The book contains references to the original papers published before the latter half of 1902, and should prove useful to those wishing to study the subject. H. A. W.

Carnet de Notes d'un Voyageur en France. Par A. C. Poiré. Pp. viii + 169. (London: Macmillan and Co., Ltd., 1903.) Price 1s. 6d.

M. Poiré intends this note-book for boys who will in the future be merchants and manufacturers. The provinces and important commercial centres of France are described only from industrial, commercial and agricultural points of view; historical, administrative and geographical details have been omitted as being unnecessary for the particular class of student for whom the book is written.

At the bottom of each page is a vocabulary of difficult or unusual French words. By the time the student has worked through the volume he will not only have much improved his knowledge of French, but have acquired considerable acquaintance with the characteristics of different parts of France.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Radium Emission.

Concerning the recently discovered heat emission from radium, it is perhaps worth noting that it appears to be connected with, and is probably an immediate consequence of, the remarkable observation by Rutherford that radium emits massive positively-charged particles, which are probably atoms, with a velocity comparable to one-tenth of the speed of light (see *Phil. Mag.*, February, 1893).

Because it is easy to reckon that the emission of a million heavy atoms per second, which is a small quantity barely weighable in a moderate time such as a few weeks (being about the twentieth part of a milligramme per century), with a speed equal to one-tenth that of light, would represent an amount of energy equal to one thousand ergs per second; that is to say, would correspond to heat enough to melt a milligramme of ice every hour. And inasmuch as these atoms are not at all of a penetrating kind, but are easily stopped by obstacles, they would most of them be stopped by a small thickness of air, and their energy would be thus chiefly expended in the immediate proximity of the source, which source would thereby tend to be kept warm.

It would appear on this view as if by enclosing a bit of radium in a small chamber formed of massively obstructing non-conducting walls that it could be made quite hot; provided always that the assumed necessary stimulus, or external supply of molecular energy, could get at it uninterruptedly.

If, in the open, the rate of escape of heat were such that on the average it accumulated for one minute before escaping, the temperature of source and ambient air, with an assumed heat-capacity equal to that of one milligramme of water, would amount to one and a half degrees centigrade. Oliver Lodge.

March 28.

Radio-activity of Ordinary Materials.

In connection with the article by Mr. Strutt on this subject in Nature of February 19, and the letter by Prof. J. J. Thomson in the following week, it may be of interest to mention some work along similar lines that has been in progress in the McGill Physical Laboratory since September last.

At the same meeting of the American Physical Society in Washington last December, at which the interesting paper of Dr. MacLennan and Mr. Burton, referred to by Prof. J. J. Thomson, was presented, an account was given by Mr. H. L. Cooke and myself of some results showing that a very penetrating radiation was given off from the walls of buildings and from the surface of the earth itself.

The primary object of this investigation was to see if the natural ionisation of air observed in closed vessels was due, in part at least, to an external radiation which passed through the walls of the vessel. For this purpose the rate of discharge of a gold leaf electroscope in a brass vessel of about 1 litre capacity was observed. When the closed vessel was surrounded by thick screens of lead and iron, the rate of discharge was reduced about 30 per cent. A similar effect was observed when the electroscope was immersed in a deep water tank. No further reduction of the discharge was observed when the electroscope was surrounded with five tons of lead. These results showed conclusively that about 30 per cent. of the ionisation in closed vessels was due to an external radiation of great penetrating power which passed readily through 1 cm. of lead. In a brass electroscope, surrounded by thick screens, the number of ions produced was reduced to as low as five per c.c. per second. In the course of these experiments, Mr. Cooke observed that a layer of brick round the electroscope *increased* the rate of discharge instead of diminishing it, pointing to the conclusion that the brick was itself radio-active. Mr. Cooke has extended these observations, using cylinders of different metals placed inside the electroscope, with results of a similar character to those already recorded by Mr. Strutt in his article.

In addition, wood as well as brick was found to be strongly active under the conditions employed. Metals exposed for some time outside the buildings showed a marked increase of activity over the metal which had been carefully cleaned.

E. Rutherford.

McGill University, Montreal, March 12.

Mendel's Principles of Heredity in Mice.

The points raised by Mr. Bateson in Nature of March 19 cannot be discussed within the limits of a short letter; a full discussion will be published in an early number of *Biometrika*. In the meantime I would ask Mr. Bateson one question:—

He represents the mice used by Mr. Darbishire as differing in two characters; one (pinkness of eye with white coat) he calls G; the other (pinkness of eye with some colour in the coat) he calls G′. The hybrids produced by crossing these mice he calls GG′; and by reference to the mysterious properties of "heterozygotes" any difficulties presented by their eye-colour are avoided. But when these hybrids are paired *inter se*, they are said to produce offspring of three kinds, in the proportions

$$GG + 2GG' + G'G'.$$

Now the mice G′G′ are of the same constitution in respect of all the characters concerned as their pure-bred grand-parent G′. Mr. Darbishire has shown (*Biometrika*, vol. ii. part ii.) that they do not always resemble their grandparent, or either of their parents, in one of the characters (coat-colour) denoted by G′. They may show a new colour, "lilac," not present in any of their near ancestors. Six out of eighteen mice of this category, at present old enough for study, show lilac colour.

I would ask Mr. Bateson's explanation of this fact and of the coat-colour of the first hybrids GG′.

Oxford, March 24.

W. F. R. Weldon.

Historical Note in regard to Determinants.

In the last-issued part of the *American Journal of Mathematics*, vol. xxv. pp. 97–106, there is a short paper by Mr. E. D. Roe entitled "Note on Symmetric Functions" which in my opinion should not pass unnoticed. It concerns two fundamental theorems regarding alternants which it appears Mr. Roe had previously dealt with in the *American Mathematical Monthly*, vol. vi. (1899) p. 25, and had been there attributed by him to Prof. Gordan. In a footnote he now says:—

"Prof. Metzler has kindly called the writer's attention to the reference to Muir ('Determinants,' p. 176, § 129), from which it appears that Muir has the priority of publication, as far, at least, as theorem i. is concerned. It may, however, be added that in a recent letter Prof. Gordan states that he has used the two theorems for thirty years."

From this it might possibly be inferred that my publication of the said theorem twenty years ago, and Gordan's alleged private use of it thirty years ago, are matters of moment in connection with its history. This would be a fatal error, as the theorem has been in print for at least *seventy-eight* years, having been exhaustively dealt with by Schweins in his "Theorie der Differenzen und Differentiale, . . ." published at Heidelberg in 1825.[1]

The part of my connection with it which gives me most satisfaction is not the fact that I discovered it for myself, but that I discovered an earlier and neglected discoverer of it, Schweins, and have since tried my best to do justice to his merits. His treatise had been absolutely lost sight of, even in Germany, until the appearance of my paper, "An Overlooked Discoverer in the Theory of Determinants," which was published in the *Philosophical Magazine* for November, 1884. In this paper was given a brief account of that portion of his work which concerned *general* determinants, and at the same time it was indicated that this was but a small fraction of the whole contents, several *special* determinants being equally familiar to him. In 1888 the subject was returned to, and entered into more fully in the *Proceedings* Roy. Soc. Edinburgh, vol. xv. pp. 526–542, the account there given being afterwards republished in the first volume of my "History of Determinants," pp. 157–173. At a later date Schweins's chapter on alternants, extending to about thirty pages, was dealt with in a similar manner, the account appearing in a paper in the *Proc.* Roy. Soc. Edinburgh, vol. xxiii. pp. 93–132. On pp. 98–103 of this the theorem will be found, accompanied by considerable detail. To the present day, nevertheless, Schweins has not received his due from any of his own countrymen.

Speaking generally, I would urge that the greatest possible caution should be exercised by everyone who finds it necessary to attach to a theorem the name of an author, not merely when the theorem concerns alternants, but when it belongs to any part of the general subject of determinants. As a second example, let us take a case where the mathematician who is unfairly dealt with is not German but English. No fact ought to be better known than that the first discoverer of continuants was Sylvester, his paper containing the discovery having been published in the *Philosophical Magazine* for June, 1853. In the early part of 1875, however, S. Günther published a text-book which assigned the credit to the Danish mathematician, C. Ramus, and notwithstanding the fact that an effort was made in the *Philosophical Magazine* for February, 1877 (vol. iii. pp. 137–138), and still more pointedly in the *American Journal of Mathematics* for 1878 (vol. i. p. 344) to rectify the error, it has lingered on in Germany and the Continent of Europe to the present day. The details of the story are instructive. Günther's statement was:—

"Die Möglichkeit einer solchen Darstellung scheint zuerst von Ramus (*Kjöbenhavn, Vid. Selsk. Overs.* 1855, pp. 106–119) bemerkt worden zu sein: auch Spottiswoode (*Crelle's Journ.*, li. p. 374) und Heine (*Crelle's Journ.*, lvi. p. 97) wurden im Verlaufe anderweitiger Untersuchungen auf dieselbe geführt."

This was republished in 1877 without alteration. In opposition to it the following are the facts:—

(1) As above stated, Sylvester's discovery was published in June, 1853.

(2) Spottiswoode, writing in August of the same year, and having just become familiar with Sylvester's discovery, reproduced the substance of the latter's remarks in the second edition of his "Elementary Theorems Relating to Determinants," which appeared in *Crelle's Journal* in 1856.

(3) In September, 1853, Sylvester returned to the subject (*v. Phil. Mag.* [4] vi. pp. 297–299).

(4) In August, 1854, a result of Sylvester's on the subject appeared in the *Nouv. Annales de Math.*, xiii. p. 305, under the significant title "Théorème sur les Déterminants de M. Sylvester."

(5) In 1855, as Günther states, Ramus made his communication.

These five assertions have always been easily verifiable; and since the claim made publicly in 1877 and 1878, ought to have been verified by any writer who had to refer to the subject. Strange to say, this has never been done, the most recent text-book, Pascal's, having only got as far as the following sentence indicates:—

"I primi che si sono occupati dell' argomento sono stati Ramus, Sylvester, Spottiswoode, Heine, Thiele, e Günther."

If we turn for aid on such matters to the *Encyklopadie der math. Wissensch.*, which is now in course of publication, and aims at being a standard work of reference, there is nought for us but disappointment. In connection with alternants, therein called "Vandermonde'sche" or "Potenzdeterminanten," the name of Schweins is not mentioned, and as for the early history of continuants, we find the old confusion worse confounded. Ramus's paper, it is true, does not appear, but unfortunately we are referred to one of still later date (1858), by Painvin, and to a note which is attributed to Sylvester, but which Sylvester never wrote. The name "continuant," too, is wrongly attributed, and when in connection with the application to continued fractions Sylvester's name is again mentioned, the first date attached thereto is 1859! This may be a misprint for 1853, but if so there is a further error in the specification of the page. Heine's name is still to the fore; unluckily, however, it is not attached to the right paper. Something of Günther's is referred to, but the title is left out.

Cape Town, S.A., February 28.

Thomas Muir.

[1] *V.* the second Abtheilung (pp. 369–398) and the second chapter of it in particular.

A RECENT STUDY OF MALARIA.[1]

When Drs. Stephens and Christophers, the Royal Society's Commission on Malaria, were in India, Captain James had the advantage of being associated with them, and the present volume contains the result of his own observations, both at that time and since. The writer first gives a detailed and eminently practical description of the methods he has found most useful for detecting the malarial parasite in the blood of patients, and for tracing its further development in mosquitoes. An important point to which he draws attention is that the hospitals and jails of India are seriously discounted as fields for the study of the malarial parasite by the fact that the great majority of the patients are under the influence of quinine, in which case the parasites are apt to be banished from the peripheral circulation. In the investigation of malaria among the general population the same fact holds for India as Koch, Stephens, and Christophers have independently found for Africa, namely, that in any place which is more or less malarious, a certain number of young children will have malaria parasites in their blood, and the percentage of young children so affected affords the most accurate test of the amount of malaria and the liability to infection existing there. The percentage of infected children, or, as it is called, the "endemic index," is therefore the first thing to determine when investigating a village for malaria. The variety of parasites present in the children's blood, and the number of cases of "large infection," are further points to be observed, for if there are a good number of large infections, there will be more likelihood of finding infected anopheles. A search is then made for adult anopheles in the houses, outhouses, and stables, the variety and relative abundance of each species is noted, and it is determined by dissection (1) what species of anopheles are carrying malaria at the time, and (2) the percentage of these infected with sporozoites. Thirdly, a careful and detailed investigation is made in order to determine the exact position and extent of the breeding grounds of each species of anopheles present, special attention being paid to the breeding grounds of the species found to be infected. In the words of Captain James, "Every pool, stream, and collection of water of any kind within a radius of half a mile of the village should be thoroughly searched for larvæ." The accurate knowledge of the conditions determining the prevalence of malaria in the place under examination thus obtained permits of a definite system of prophylaxis being formulated for that place. An important point emphasised by Captain James is that no general system of prophylaxis will apply to every place, but that the malarial individuality of each must be studied.

As a model of what a malarial survey should be, he quotes the survey of Ennur, made in February, 1902. Ennur is a village on the coast near Madras, and was formerly a health resort for Europeans, but is now deserted by them on account of the fact that it is scarcely possible to pass even a single night there without getting fever. The source of infection was found to be the native children, 55 per cent. of whom had malarial parasites in their blood. With regard to the variety of parasite present, 81 per cent. of the infected children showed quartan parasites only, 5 per cent. tertian only, and 14 per cent. mixed infection. No malignant tertian parasites were found. Investigation of the mosquitoes showed that only two species were present in the houses, viz. *A. Rossii*, which was in great abundance, and *A. Culefacies*, which was moderately so. Dissection, however, showed that, while not one of 240 specimens of *A. Rossii* examined was infected, no less than 8.7 per cent. of *A. Culefacies* contained sporozoites. Captain James concludes that *A. Culefacies* is the chief carrier of malaria at Ennur, and that the high infection rate of this species indicates the great liability to infection of anyone residing in the place. Extensive breeding grounds for mosquitoes surrounded the village, the nearest being within ten to twenty yards of the houses. *A. Culefacies* was found to be breeding almost exclusively in the "borrow pits" by the side of the railway, and in the tanks in the compounds of the deserted European bungalows.

The observations of Captain James on malarial infection of native children have resulted in an important addition to our knowledge of this subject, for by careful investigation he has shown that the same febrile disturbance takes place in children about the time of segmentation of the parasites in their blood as in the case of adults, and that there is, in short, no essential difference between child infections and those occurring in adults.

The chapter on the causes which influence the spread of malaria in different parts of India, in which the writer has been helped by Drs. Stephens and Christophers, is one of the most valuable in the book. The data therein cited clearly show the great general influence on the prevalence of malaria due to the particular species of anopheles present, and to the nearness and abundance of anopheles' breeding grounds. The number of species of anopheles in India is large, and previous description of them inadequate. A considerable and well-illustrated part of the present monograph therefore is devoted to the differentiation of the various species of Indian anopheles, and promises to be of high practical value in future malaria investigations. The remarks on the subject of the favourite breeding places of the various species of anopheles are also of importance, and show how thorough inquiry in this direction ought to be. Captain James's observations on the usual distance of flight of anopheles in India go to show that this rarely, if ever, exceeds half a mile, and therefore that at this distance from a focus of infection "we are practically safe from malaria." With regard to the influence of altitude, it has been found that under 4000 feet has no effect by itself on the prevalence of malaria in India.

In reference to the prevention of malaria, the following remarks of Captain James are significant:—"Complete protection from malaria (and Blackwater fever) may be ensured by any individual who is willing to take the trouble to pay scrupulous attention to the use of a good mosquito curtain at night, and to adequately protect himself from being bitten by mosquitoes during the evening hours. If these simple precautions are taken it is quite unnecessary to use quinine as a prophylactic. No other precautions than these have been used by any of us during our tours through some of the most malarious parts of India, and none of us has experienced a day's fever during this time. By the use of the same precautions also, and without taking any quinine, Dr. Stephens previously passed two years in the most malarious parts of Africa without a single attack of malaria." When such success attends the adoption of simple measures of defence against malarial mosquitoes, there is good reason for hoping that additional preventive measures, such as separation of the residences of Europeans by a distance of at least half a mile from the dwellings of natives, and, above all, destruction of the breeding grounds of anopheles, will do much to eliminate a disease the death-tribute to which has been already far too costly.

M. H. Gordon.

[1] "Malaria in India." By Captain S. P. James, M.B. (Lond.), I.M.S. Issued under the authority of the Government of India by the Sanitary Commissioner with the Government of India, Simla. Published by the office of the Superintendent of Government Printing, Calcutta, 1902. Pp. 106. Price Rs 1-8, or 2s. 3d.

THE ANDAMANS AND NICOBARS.[1]

Although much valuable information regarding the two most interesting groups of islands in the Bay of Bengal, known from very early times as the Andamans and Nicobars, has been published in Indian official reports and in scientific papers by officials of the islands, or by visitors to them, there is, so far as we know, no general connected monograph of them. The present volume will be welcomed, therefore, as containing an account of a three months' cruise among them, undertaken, in 1901, by the author's companion and host, Dr. W. L. Abbott, owner of the American schooner yacht *Terrapin*, of Singapore, to obtain collections of natural history, especially small mammals and ethnological objects, for the National Museum, Washington, U.S.A. It is well illustrated with photographs by the author, two maps and a hydrographical chart. We note that many of the ethnological portraits have been taken in full sunshine, and are disfigured by heavy, black shadows. Better results would have been obtained by photographing the subjects in the shade against a dark background, giving full exposure.

The first part of the book is devoted to the narrative of the cruise, and contains many interesting notes and observations upon the different islands visited, their inhabitants, fauna, flora, and physical characteristics. It opens with hints about the equipment and provisioning of a yacht for cruising in Indian seas, also regarding the guns and ammunition most suitable for a collecting naturalist. Crossing from Mergui early in January, the party first touched at Barren Island, a volcano which appears to be steadily cooling down, and passing through the Quangtung Strait, visited the convict settlement at Port Blair. Then touching at the South Andaman and the Cinques, they went to the north part of the Little Andaman, inhabited by the Öngés, who received them well. Here they found large thatched huts, very different from the palm-leaf shelters used by the natives of the northern isles.

Leaving the Andamans, they went south to the village of Mūs, in Sawi Bay, on Kar Nicobar. They were immediately struck by the entire change in place and people, from the dense forests of the Andamans to open grass land and groves of coco-palm, and from a little black-skinned, grizzly-haired Negrito race in an exceedingly low plane of existence and of little intellectual capacity, though well made and by no means repulsive in appearance, to a brown-complexioned, lank-haired, muscular people of Malay race, of fair height, intelligent and good linguists, almost semicivilised, living in well-built dwellings, cultivating food products, and possessing domesticated animals. The author gives a very interesting description of the village of Mūs, and of some peculiar institutions found there; the public halls for meetings and feasts, the maternity huts and huts for the dying on the outskirts. They then went to Tiliangchong, a forest-clad, uninhabited island where good collections of birds were made, and on to Trinkat. A week was spent in the beautiful harbour of Nankauri between the Islands of Camorta and Nankauri. A good account is given of the village of Malacca, or Nankauri, and of the customs of the inhabitants, which differ from the Kar Nicobarese. Of the convict settlement at Camorta, on the north side of the harbour, little now remains beyond

Fig. 1.—Huts of the Shom Peñ. (From "In the Andamans and Nicobars.")

[1] "In the Andamans and Nicobars" The Narrative of a Cruise in the schooner *Terrapin*, with Notices of the Islands, their Fauna, Ethnology, &c. By C. Boden Kloss. Pp. xvi+373. (London: John Murray, 1903.) Price 21*s*. net.

two graves, one being that of the unfortunate De Röepstorff, killed in 1883, whose memory is still cherished by the natives, and will not readily be forgotten by the members of the Eclipse expedition of 1875, for whom he did so much. He was one of the first to make a scientific study of these islands.

Leaving the harbour by the western exit, the party visited Dring, on Camorta, and thence passing by Bompoka, Teressa and Chaura, where all the Nicobar pottery is made, they anchored off Kachal, where they first found monkeys, and then crossed the Sombrero Channel to the island of Little Nicobar, east of Pulo Milo, where they found good anchorage. The author suggests this as a site for any future European settlement on account of the harbour, the fertility of the soil, and the presence of water. Here monkeys abounded, and in some caves they found a new leaf-nosed bat and the birds-nest swift living together, but never occupying the caves at the same time. After a halt at Kondul, they went to the north side of the Great Nicobar and spent nearly a month visiting villages on the west coast, ending with an excursion up the beautiful valley of the Galatea River. In this island they found some fairly civilised members of the Shom Pen tribe, who live in the interior, and many photographs of them are given. Fig. 1 shows one of their huts with a diagonal bracing to the props. The party left Singapore early in April.

In the second part, which is largely a compilation, the author discusses the two groups of islands more fully, as regards their history, geological formation, climate, products, languages, ethnographical characteristics and origin of the different races of inhabitants. Several illustrations are given of the ornaments, weapons, &c., used in both groups, and of the curious carved wooden images and painted screens used as charms or scare-devils by the Nicobarese. Dampier's narrative of his experiences in the Great Nicobar, in 1688, is reprinted, also an extract from an old account of Kar Nicobar by Dr. J. G. Koenig, a pupil of Linnæus. There is an account of the Kar Nicobarese from information given by Mr. V. Solomon, a Christian catechist who has lived among them for many years.

At p. 320, the author has given a summary of his conclusions regarding the origin and variation of the fauna of these islands, based on the theory that the two groups are surrounded by deep sea, except on the north, towards Arakan, and that consequently they have never been connected with the Malay peninsula or Sumatra, and could not have derived their fauna from them. On his hydrographic chart, at p. 166, he shows a wide deep sea channel of more than 1000 fathoms running in from the west between Great Nicobar and Sumatra into the deep Andaman Sea. The depth of this channel has usually been put at about 760 fathoms, but in the latest chart of this part of the Indian Ocean there seems to be no such deep-sea passage between the islands, but a distinct shallowing with a ridge, over which the depth of water does not exceed 950 fathoms in the deepest part about midway between them. The author also estimates the depth of the Ten-Degree Channel at 600 fathoms, but the chart shows a ridge between Little Andaman and Kar Nicobar at a depth of not more than 450 fathoms. The fact that these channels and other ocean depths are so much shallower than the author has been led to believe may modify his conclusions. The question of the geological, zoological and botanical relationships of these islands is a very difficult one, and has engaged the attention of officers of the Indian scientific services for many years past. A great deal has been published on the subject in the official records of the Indian Museum, Marine and Geological Surveys, and the *Journal* of the Asiatic Society of Bengal, which the author seems to have overlooked, and a notice of which would have greatly enhanced the value of the book.

To zoologists, the fact that sixteen new species of mammals and ten hitherto undescribed species of birds from the two groups of islands were collected by Dr. Abbott and the author will be of interest. The former have been fully described by Mr. G. A. Miller, jun. (*Proc.* Nat. Museum, Washington, U.S.A., xxiv., 1902), but, considering that they include some well known forms, and that the islands have been constantly visited by experienced collectors from India for many years past, their all being new is doubtful. The same may be said of the new birds, a list of which is given by the author at p. 331.

Lists of the mammalian fauna, and of the birds of both groups, including the new species, are given with notes on their distribution. The work concludes with appendices relative to the climate, forest trees and timbers, population, education, &c., of the Andamans, also to the flora, population, trade articles, presents and barter, besides tables of measurements of members of different tribes of Nicobarese.

The author has had the great advantage of the assistance of Mr. E. H. Man, who is the greatest living authority on the islands, and the book is a very useful work of reference regarding them. J. W.

PULKOVA OBSERVATIONS OF NOVA PERSEI.

The Pulkova Observatory has recently issued[1] a valuable contribution to our knowledge of Nova Persei, which attracted so much attention at the beginning of the year 1901. The observations which are here brought together and discussed were those made by M. Belopolsky, and were, for the main part, chiefly of a spectroscopic nature, both photographic and visual.

Fortunately, the high latitude of the observatory allowed this observer to photograph the spectrum of the star during its lower culmination, so that he was able to secure a complete series of 71 photographs, extending from February 26 to June 4; after this date, long exposures became impossible, and eye observations were substituted. In the first instance, the spectroscope employed was mounted on the astrographic refractor, but later (March 31) the 30-inch was substituted. In the present volume, M. Belopolsky gives a very complete account of each photograph, adding the reduced wave-lengths after the computation by the Cornu-Hartmann formula.

It will be remembered that the spectrum of this star underwent rapid changes, not only in intensity, but in the number and positions of the lines. The numerous bright lines with their dark components gradually became less in number, and when the Nova's magnitude began to undergo the short period light changes, the spectrum indicated a stellar and nebulous stage alternately; eventually, as the Nova grew fainter, the nebular spectrum predominated. All these changes are described in detail by M. Belopolsky, and he further gives the measurements of the width, intensity and displacement of the hydrogen and other lines at different epochs of the Nova's life.

In the discussion of the whole set of observations, this observer comes to conclusions which are different from those that are at present generally held. Thus, for instance, he is not inclined to believe that the displacements are due to movements of the Nova according to the Doppler-Fizeau principle. One of his reasons

[1] Publications de l'Observatoire Central Nicolas, vol. xvii. séries ii., 1902.

against this hypothesis is that, as in all new stars, the dark absorption bands are always on the violet side, and the bright radiation bands displaced towards the red; this implies that the former always move towards and the latter away from the sun, which, as he says, is highly improbable. M. Belopolsky does not consider the displacement of the bright lines towards the red end of the spectrum real at all, but only illusionary, in consequence of their unsymmetrical appearance. This unsymmetrical appearance is due, as he suggests, to the absorption bands, which lie nearer to the violet edges of the bright bands. In fact, he says, "streng gesagt existeren keine Ränder der Emissions-Banden," but that they merge into the continuous spectrum; it is only the existence of absorption bands which gives them their sharp edges on the violet side.

Another point which M. Bolopolsky dwells upon at some length is the apparent peculiarities in the behaviour of the intensities of some of the hydrogen and cleveite gas lines, and he is inclined to attribute these interchanges of intensity to actual changes of the lines themselves. Other observers have been more inclined to explain such apparent abnormal features by assuming that a neighbouring line of other origin was becoming bright, while the original line was on the wane. Thus, for instance, when the hydrogen spectrum of the Nova was dimming very considerably and the lines were all weak, one of the hydrogen lines, $H\epsilon$, on the other hand, was becoming stronger. Since the weakening of the hydrogen lines was accompanied by a strengthening of the nebular lines, it was fair to assume that at, or close to, the position of $H\epsilon$ a new line of unknown origin had made its appearance, especially if it were of a similar nature to the nebular lines.

Enough, perhaps, has been said to indicate the general lines M. Belopolsky has followed. There are, however, many other points, such as the individual structure of the bright bands (M. Belopolsky has divided $H\gamma$ into twenty-four and $H\delta$ into twenty-eight parts), to which reference might be made, but these must be left to those readers who will read the original. Four plates accompany the text, the first two giving in diagrammatic form the intensity curves of the hydrogen bands, and the rest reproductions of the spectra of the Nova, with the terrestrial comparison spectra on different dates. It seems a pity that the latter are so very narrow that it is difficult, even with the aid of a lens, to identify more than the very general features, while one can assume that the originals were full of detail.

WILLIAM J. S. LOCKYER.

THE BRITISH ANTARCTIC EXPEDITION.

THE first news of the British Antarctic Expedition since the departure of the *Discovery* from New Zealand in December, 1901, has been brought by the relief vessel *Morning*, commanded by Captain Colbeck, which arrived at Lyttelton on March 25. Captain Colbeck found the *Discovery* in MacMurdo Bay (Victoria Land) on January 23, 1902; all was well on board and only one serious casualty had occurred—the loss of a seaman named Vince, who fell down an ice-slope into the sea and was drowned. Commander Scott's official report of the voyage of the *Discovery* up to the time of meeting with the *Morning* has been telegraphed home by Reuter, and is as follows:—

The *Discovery* entered the ice pack on January 23, 1902, in latitude 67° south. Cape Adare was reached on January 9, but there a heavy gale and ice delayed the expedition, which did not reach Wood Bay until January 18. A landing was effected on January 20 in an excellent harbour situated in latitude 76° 30′ south. A record of the voyage was deposited at Cape Crozier on January 22. The *Discovery* then proceeded along the barrier within a few cables' length, examining the edge and making repeated soundings. In longitude 165° the barrier altered its character and trended northward. Sounding here showed that the *Discovery* was in shallow water. From the edge of the barrier high snow slopes rose to an extensive heavily glaciated land with occasional bare precipitous peaks. The expedition followed the coast line as far as latitude 76°, longitude 152° 30′.

The heavy pack formation of the young ice caused the expedition to seek winter quarters in Victoria Land.

On February 3 the *Discovery* entered an inlet in the barrier in longitude 174°. A balloon was sent up, and a sledge party examined the land as far as latitude 78° 50′. Near Mounts Erebus and Terror, at the southern extremity of an island, excellent winter quarters were found. The expedition next observed the coast of Victoria Land, extending as far as a conspicuous cape in latitude 78° 50′. It was found that mountains do not exist here. Huts for living and for making magnetic observations were erected, and the expedition prepared for wintering. The weather was boisterous, but a reconnaissance of sledge parties was sent out, during which the seaman Vince lost his life, the remainder of the party narrowly escaping a similar fate. The ship was frozen in on March 24. The expedition passed a comfortable winter in well sheltered quarters. The lowest recorded temperature was 62° below zero.

The sledging was begun on September 2, parties being sent out in all directions. Lieutenant Royds, Mr. Skelton and party established a "record" in an expedition to Mount Terror, travelling over the barrier under severe sleighing conditions, with a temperature of 58° below zero.

Commander Scott, Dr. Wilson, and Lieutenant Shackleton travelled ninety-four miles to the south, reaching land in latitude 80° 17′ south, longitude 163° west, and establishing a world's "record" for the farthest point south. The journey was accomplished under trying conditions. The dogs all died, and the three men had to drag the sledges back to the ship. Lieutenant Shackleton almost died from exposure, but he has now quite recovered. The party found that ranges of high mountains continue through Victoria Land. At the meridian of 160° foothills much resembling the Admiralty Range were discovered.

The ice barrier is presumably afloat. It continues horizontal, and is slowly fed from the land ice. Mountains 10,000 feet to 12,000 feet high were seen in latitude 82° south, the coastline continuing at least as far as 83° 20′ nearly due south. A party ascending a glacier on the mainland found a new range of mountains. At a height of 9000 feet a level plain was reached, which was unbroken to the west as far as the horizon.

The scientific work of the expedition includes a rich collection of marine fauna, of which a large proportion are new species. Sea and magnetic observations were taken, as well as seismographic records and pendulum observations. A large collection of skins and skeletons of southern seals and sea birds has been made. A number of excellent photographs have been taken, and careful meteorological observations were made. Extensive quartz and grit accumulations were found horizontally bedded in volcanic rocks. Lava flows were found in the frequently recurring plutonic rock which forms the basement of the mountains.

Before the arrival of the *Morning* the *Discovery* had experienced some privation owing to part of the supplies having gone bad. This accounted for the death of all the dogs. She was revictualled from the *Morning*, however, and the explorers are now in a position to spend a comfortable winter.

As the *Discovery* left Port Chalmers on December 24, 1901, and reached Cape Adare on January 9, 1902, the statement that she entered the pack ice on January 23 is obviously an error; the correct reading is probably "January 2–3."

In addition to the above, the following telegrams have been transmitted by Reuter, under dates March 26, 27, and 28:—.

Captain Colbeck, of the *Morning*, said in the course of an interview that he thought the chances of the *Discovery* being free this season were doubtful.

Nine of the *Discovery's* seamen, who are tired of the

work, have returned on board the *Morning*. Lieutenant Mulock has replaced Lieutenant Shackleton, who is invalided.

The sledge journey of Captain Scott, Dr. Wilson, and Lieutenant Shackleton, which resulted in the farthest point south being reached, took ninety-four days.

After the explorers had left a depôt which had been previously established sixty miles south of the ship, the snow became soft, and it was almost impossible to drag the sledges along. Half of the sledges had to be hauled five miles, and then the party returned and brought up the remainder, each five miles covered thus involving fifteen miles of travelling. This relay work lasted twenty-nine days.

The explorers established a depôt in latitude 80° 30′ south, and then discarded all superfluous gear, and set out on December 15 for a dash to the south. On January 1 they reached latitude 82° 17′ south. The southernmost depôt was regained on January 15, and the ship on February 3.

Lieutenant Armitage, second in command, on a sledge journey which he made to the westward, and which lasted fifty-two days, attained an altitude of 9000 feet. The party descended an ice slide to a glacier 3000 feet below. At one point of the journey they slid a distance of 1300 feet in one minute ten seconds, hanging by straps to the backs of the sledges. On the return journey Lieutenant Armitage fell into a crevasse and hung thirty feet below the surface. If he had not been harnessed to the others he would have fallen a depth of 2000 feet. In some places the sledges had to be lowered fifty feet, and then hauled up on the other side.

Captain Colbeck's opinion as to the *Discovery's* chances of getting clear of the ice is somewhat difficult to understand, as the *Morning* transferred a large quantity of stores to the *Discovery*, and had apparently no difficulty in getting out again, while it may be supposed that Commander Scott's decision to remain for another winter was made deliberately in pursuance of his original intention to spend two winters in the Antarctic regions. Further details will be awaited with great interest; the situation of the *Discovery*, as well as the statement in the last paragraph of the official report, emphasise the soundness of the policy which led to the dispatch of a relief vessel.

Even with the meagre information to hand, it is abundantly evident that the National Antarctic Expedition has already achieved a great success, both in the way of exploration and of scientific observation. The "record" for south latitude has been "broken" by one hundred miles, and, what is more important, an unknown mountain region, extending to at least 83° 20′ S. lat., has been discovered, suggesting, as Sir Clements Markham has remarked, that "land stretches to the Pole in a series of lofty mountains." The fact that the *Discovery* wintered at a point four hundred miles further south than any former expedition encourages the belief that her observations will be of real value to science—solving some of the crucial problems of terrestrial physics. Even greater results may be expected from the work still to be done, for Commander Scott and his comrades have the experience of one successful year to help them.

The success of the British expedition makes us look forward with the more interest to news from the German and Swedish expeditions, which are working in the "Weddell" and "Enderby" quadrants, and from which we may hear at any time. The Scottish Antarctic expedition will probably not be heard from for a year, as the *Scotia* only left the Falkland Islands on January 22, 1903, and Mr. Bruce, who is in command, has materially altered his plans, as appears from the following letter which he has sent to Reuter's Agency:—

"In a few hours we take our departure for the south. Contrary to my previous intention, I am going to winter the ship if we find a suitable winter harbour, for, on account of the lateness of the season, there will not be time to set up a separate house and set the ship free. We had a most successful passage south, having accomplished the voyage in fifty-nine days, in contrast to ninety-two days that we took in the *Balaena* in 1892. Systematic hydrometer observations and temperature observations of the surface of the sea from 30° N. have been taken, and those of the River Plate should prove of exceptional interest, since there are most remarkable and rapid changes both in density and temperature associated with strong currents. We have inspected and set up the meteorological station at Cape Pembroke, which should be as good as any in the Southern Hemisphere. This should form a very important sub-Antarctic station. We have sufficient funds to enable us to do this one year's work in the south. Now that we are on a solid basis it would be a great pity to come home before our work is really complete. A second winter, during which the ship could be kept going free, as well as the station, would be most valuable."

NOTES.

THE presidents of the sections of the British Association, for the meeting to be opened at Southport on September 9, are as follows:—*Mathematical and Physical Science*, Mr. C. V. Boys, F.R.S. (Chairman of Department for Astronomy and Meteorology, Dr. W. N. Shaw, F.R.S.); *Chemistry*, Prof. W. N. Hartley, F.R.S.; *Geology*, Prof. W. W. Watts; *Zoology*, Prof. S. J. Hickson, F.R.S.; *Geography*, Captain Ettrick W. Creak, C.B., F.R.S.; *Economic Science and Statistics*, Mr. E. W. Brabrook, C.B.; *Engineering*, Mr. C. Hawksley; *Anthropology*, Prof. J. Symington; *Botany*, Mr. A. C. Seward, F.R.S.; *Educational Science*, Sir William de W. Abney, K.C.B., F.R.S. On Friday, September 11, a discourse on "Man as Artist and Sportsman in the Palæolithic Period" will be delivered by Dr. Robert Munro, and on Monday, September 14, Dr. Arthur Rowe will lecture on "The Old Chalk Sea, and some of its Teachings."

THE *Times* of Monday contained in its latest intelligence columns two telegrams from the United States, one dated March 28 and the other March 29, both of which had been transmitted "By Marconigraph." This starts, as the *Times* says in a leader, a day-by-day transmission of news between the New and the Old World, undertaken on a contract basis, and thus distinctly marks a step forward in the development of wireless telegraphy. Mr. Cuthbert Hall stated to a representative of the *Westminster Gazette* that until the Post Office has granted the land connection for which the Wireless Co. ask (which has been granted in Canada and the United States), it is impossible to extend generally to the public and the Press the facilities afforded to the *Times*. Nevertheless, Transatlantic wireless telegraphy may now be considered on a practical commercial footing, since it is evident that the Marconi Co., and the *Times* also, feel confident of its trustworthiness if they make it the basis of an arrangement of this kind. We offer our sincere congratulations to Mr. Marconi on this advance. We have frequently commented in these columns on the extreme rapidity with which the practical development of wireless telegraphy has progressed in Mr. Marconi's hands; the present occasion affords another instance in point. There is pleasure in the remembrance of the part which pure science has played in leading to this development.

THE following have been elected fellows of the British Academy:—Dr. B. Bosanquet, Prof. E. G. Browne, Mr. Arthur Cohen, K.C., Mr. F. C. Conybeare, Prof. F. Y. Edgeworth, Dr. C. H. Firth, Prof. A. Campbell Fraser, Sir Edward Fry, Dr. F. J. Furnivall, Prof. P. Gardner, Dr. Henry Jackson, Dr. M. R. James, Dr. F. G. Kenyon,

Prof. W. P. Ker, Lord Lindley, Sir A. Lyall, Prof. W. R. Morfill, Dr. A. S. Murray, Prof. J. S. Nicholson, Dr. G. W. Prothero, the Very Rev. Dr. J. Armitage Robinson (Dean of Westminster), Dr. G. F. Stout. The number of the fellows is thus raised from forty-eight to seventy.

The complimentary banquet given to Sir William White on Thursday last, March 26, by the presidents, vice-presidents, and members of council of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Naval Architects, and the Iron and Steel Institute was a function to which we refer with pleasure. The leading representatives of engineering science and practice in this country were present, and the assembly showed the high appreciation in which the work Sir William White has done for the country and the Navy is held by those who are best able to judge its value. It is not often that five scientific or engineering societies unite to do honour to one of their members in this way, but the example might well be followed more frequently. Men who have devoted their lives to the progress of pure and applied science ought to be made to feel that their fellow-workers respect and admire their labours. The public recognition of Sir William White's services on Thursday last has therefore been noticed with satisfaction by many who were not present at the banquet.

During the past week the British Islands have been visited by a succession of the barometric depressions which have been prevalent for some weeks, and have occasioned a persistent continuance of mild south-westerly winds, with day and night temperatures considerably above the average. On Wednesday, March 25, the Metropolis and southern parts of England experienced thunderstorms, and thunder and lightning occurred on succeeding days in various parts of the country. At Greenwich a temperature of 68° in the shade was recorded, which is the highest registered in March since 1894, and the reports issued by the Meteorological Office show that the temperature reached 65° at Oxford, 70° at Paris, and 81° at Biarritz. A peculiar feature of this abnormal temperature was that the highest readings occurred during the evening; a correspondent at Cambridge writes that he recorded 63° at 7h. 30m. p.m. In the neighbourhood of London, a reading of 68° was recorded at 8h. p.m.; this temperature is about 27° above the average, and fully 5° above the average evening summer readings. The clouds bore a somewhat unusual appearance, known as *mammato-cumulus*, or festoon-clouds.

The following are among the lecture arrangements at the Royal Institution after Easter:—Prof. Allan Macfadyen, three lectures on the blood and some of its problems; Prof. G. H. Darwin, two lectures on the astronomical influence of the tides (the Tyndall lectures); Prof. E. J. Garwood, two lectures on the work of ice as a geological agent; Prof. Dewar, three lectures on hydrogen: gaseous, liquid and solid; Prof. S. H. Vines, two lectures on proteid-digestion in plants; Prof. J. A. Fleming, two lectures on electric resonance and wireless telegraphy; and Prof. S. P. Thompson, two lectures on the "De Magnete" and its author, (1) the book, (2) the man. The Friday evening meetings will be resumed on April 24, when a discourse will be given by the Hon. R. J. Strutt on some recent investigations on electrical conduction; succeeding discourses will probably be given by Prof. William J. Pope, Dr. D. H. Scott, the Prince of Monaco, and others.

The Italian Senate has approved a Bill for the construction of a powerful radiographic station on the Marconi system.

In the House of Commons on Monday, Sir J. Leng asked the Postmaster-General whether, in view of the fact that the Admiralty have come to an arrangement for the adoption of Marconi's system of wireless telegraphy, he would state what hindrance there is, if any, to the Telegraph Department giving the same facilities for transmitting Marconigrams over the public wires as are given to the cable companies, and can he state the present position of the negotiations. In reply Mr. Austen Chamberlain said: "I am prepared, on proof to my satisfaction that the company are in a position to deal satisfactorily with the business handed to them, subject to their compliance with certain conditions required in the public interest, to give them the necessary facilities for the transmission of telegrams to and from Poldhu station. I am in communication with the company and other departments on the subject."

The electrification of the Lancashire and Yorkshire Railway between Liverpool and Southport is nearly finished, and the lines will be opened on the new system during the present year. Thirty-two miles of feeders, which are to be worked at a pressure of 10,000 volts, have been made by Messrs. Glover, of Manchester, and have just passed the factory tests at 60,000 volts. Messrs. Dick, Kerr and Co. are the engineers for the work.

The first two trains constructed for the electrification of the Metropolitan District Railway have been delivered at South Harrow, and are being fitted with their electrical equipment. The new line from South Harrow to Ealing is being used experimentally for trial runs and so forth, power being supplied by a small station which has been specially built. The cars of the new trains are built somewhat on the same lines as those of the Central London Railway, the seats being along the sides instead of transversal. Electrical heating apparatus is installed beneath the seats. A train will be made up of seven cars, three of which, the two end ones and the middle, will be motor cars; this arrangement allows the trains to be divided into smaller units at periods of light traffic. Each car has a seating capacity of fifty, so that a complete train will carry 350 passengers in comfort, and probably as many again during busy hours, standing along the central gangway. At present no distinction of class has been made, and it is said that the company proposes to fix a uniform rate of $2\frac{1}{2}d.$ for any distance. The large generating station in Chelsea is as yet by no means finished, so it will probably be some time before the electrification is completed.

Prof. Fleming, in his final lecture on wireless telegraphy at the Society of Arts last week, dealt with the question of interception of messages, and recounted the results of some experiments he had made the week before at Poldhu. Two series of messages were sent out from Poldhu, the one from the large aërial used in Transatlantic signalling, and the other from a small mast used for short distance experimental work. Some of the messages were in cipher, and they were all secret, being known only to Prof. Fleming; they were transmitted simultaneously, and received at the station at the Lizard, where there were two receiving circuits, one tuned to the large and the other to the small aërial. The messages were sorted out perfectly and printed on separate Morse tapes. The remainder of the lecture was devoted to a comparison between the Marconi and other syntonic systems, and to a consideration of some of the unsolved problems of wireless telegraphy. The lecturer pointed out that one fault of the receiving apparatus lay in the fact that it was unable to indicate the direction from which the received radiations were coming, or to give any gauge of its distance, thus making it impossible to localise the source.

THE report of Marconi's Wireless Telegraph Co., Ltd., which has just been issued, contains some interesting particulars of the work that has been done. The list of stations which have been erected, including Lloyd's stations, contains twenty-five names; three of these are the Transatlantic stations at Poldhu, Cape Breton and Cape Cod; of the rest eight are in England, four each in Ireland and the United States, two each in Canada and Germany, and one each in the Isle of Wight and Belgium. With reference to the Navy, it is stated that thirty-two ships have already been equipped, and arrangements have been made by which the use of wireless telegraphy in the Navy will be greatly extended. The subsidiary company, the Marconi International Marine Communication Co., Ltd., is able to report satisfactory progress; seven lines of steamships are using the system, the total number of ships so far equipped being thirty-one. The report also contains a number of details concerning the work which has been done by the Company and its offshoots in Italy, France, Germany, Belgium, the United States, Canada and other countries.

Two reports referring to disturbances of the earth's crust have appeared since we went to press last week. They are as follows:—*Naples*, March 27. The activity of Vesuvius is again increasing. Explosions occur with frequency, and rumblings are heard. *Jerusalem*, March 30. A shock of earthquake occurred last night, at 12.35, throwing the entire population into a state of great excitement.

THE Board of Trade has received information, through the Colonial Office, that a uniform time, based on the 30th meridian, or two hours east of Greenwich, has been adopted by all the South African Governments with the exception of that of German South-West Africa. It is announced on the same authority that on February 28, at 11.30 p.m., the time was advanced to midnight in the Transvaal, and that similar steps were taken in the other South African colonies, except Natal, where no change was necessary.

A FEW details referring to the earthquake in the midland counties on March 24 (see p. 491) have reached us from correspondents. Mr. F. W. Shurlock says that at Derby a double shock occurred about 1.29 p.m., the two shocks being separated by a few seconds only, but no shock was felt at 1.10 p.m. At the Harris Institute, Preston, Mr. J. Harrison noticed a vibration of the building at about 1.32 p.m., and it was remarked that the suspended electric lamps were set swinging by the movement. Mr. W. French noticed a peculiar shaking of the floor of a room at Lancaster at about 1.30 p.m., and remarked that it was an earth tremor. A correspondent, writing from Rock Ferry, says there were three distinct shocks, the second being of a compound character. "There were about three principal movements in this middle shock, the first being most, and the last least, pronounced; but I could also distinguish in addition to this rolling a pitching motion at right angles to it, and a combination of the two, the greatest dip of the pitch being towards the N.E. Of the other two quakes the first had one chief motion towards the S.E., and the last had one similar but of less force, and then slight pitching which gradually died away. There was no noise, and the time the earthquake lasted appears to me to be longer than that given in the accounts I have seen." Prof. E. Wiechert records in the *Daily Mail* that the earthquake was registered by a seismograph at Göttingen.

THE death is announced of Dr. Gustav F. R. von Radde, who was born at Danzig on November 27, 1831, and distinguished himself as a naturalist. From the *Times* we learn that in 1855 he was called to St. Petersburg by the Russian Imperial Geographical Society, which was dispatching an important expedition to Eastern Siberia and Kamtchatka, to which he was attached. It extended over five years, and at the request of Count Muravieff, the then Governor General of Siberia, von Radde founded a Cossack settlement, which was named Raddowka after him, and is one of the most flourishing settlements in those parts. For the reports which he published on his travels the Russian Academy of Science awarded him the Demidoff prize, and published them at its own expense. In 1863 he accepted a call to the Caucasus and went to Tiflis. There he founded a Caucasian museum of natural history, ethnography, and archæology, of which he was made the director, a post he held until his death. He was able, nevertheless, to undertake many other scientific journeys, not only in Caucasia, but in Transcaspia and along the whole borderland of Russia in Asia, as well as in other parts of the East, which resulted in many very valuable contributions to the scientific literature of the day.

THE Royal Academy of Sciences of Turin offers the following prizes:—The Bressa prize of 9600 lire for the most valuable discovery made by an Italian in the period 1901–1904, in a large number of various specified departments covering a very extended portion of the domain of science. Two prizes of 30,000 lire, both open to foreigners, are offered, one for the best printed work on Latin literature, published in 1903–1906, the other for the most valuable work on any of the physical sciences printed in 1907–1910. Finally, a prize of 2500 lire, founded by Gautieri, is offered for the best work on philosophy, including the history of philosophy, published in 1900–1902.

THE Royal Meteorological Institute of the Netherlands has published its fifty-third year-book, containing observations and results for 1901. For the last few years the value of this publication has been much enhanced by its conformity to the scheme adopted by the International Meteorological Committee. Hourly observations are published for four stations, tri-daily observations and monthly and annual summaries for a number of other stations, and rainfall values for 106 stations. An appendix gives an interesting account of the storm-warning service; 74·5 per cent. of the warnings issued met with complete success, and 15 per cent. with partial success. Recognition is made of the value of special warning messages received from the English Meteorological Office.

WE have received from the president of the International Aëronautical Committee a preliminary report upon the balloon and kite ascents made in Europe and the United States on the morning of February 5. The space at our disposal will only allow of reference to the most noteworthy altitudes attained by the registering balloons. At Trappes the register recorded a height of 15,700 metres; the minimum temperature, $-59°·8$ C., was registered at 10,940 metres. The reading on the ground was 5°·4; at 1850 metres there was an inversion, 1°·8. At Itteville the greatest height was 15,020 metres, minimum temperature $-61°·2$ at 11,650 metres, temperature on the ground 5, inversion 0°·6 at 1880 metres. At Strassburg the low temperature of $-66°·0$ was recorded at 12,500 metres, reading at starting 0°; two inversions were shown, 2°·4 at 300 metres and 6°·4 at 1400 metres. A second balloon recorded $-62°·0$ at 12,100 metres, inversion 5°·5 at 1850 metres. These ascents were made in an area of high barometric pressure.

THE annual meeting of the Scottish Meteorological Society was held on March 25. The report of the council, presented

to the meeting, states that Sir Arthur Mitchell has resigned the office of honorary secretary, and has been succeeded by Mr. R. T. Omond. The council also reports that the work at the two Ben Nevis observatories has gone on satisfactorily. The arrangements for resuming the observations during the summer at the half-way station (2200 feet) were carried out in August last. A very complete series of observations was obtained, both at the half-way station, and also for part of the time at three other intermediate stations. Dr. Buchan has been chiefly occupied with a continuation of the discussion of the hourly observations of pressure, temperature, humidity, rainfall, and sunshine, with their inter-relations, at the Ben Nevis and Fort William observatories from 1890 to 1902. As regards the temperature and pressure inter-relations, the "constants" have now been determined for all temperature differences, for differences of 12°·0 or less, and for differences of 18°·0 or more. The relations which the results bear to the cyclones and anticyclones of north-western Europe have been pointed out. A beginning has been made with a discussion on the hourly hygrometric differences. The relations of the various hourly and daily differences thus ascertained to weather changes are also in course of examination.

Prof. T. D. A. Cockerell, of the New Mexico Normal University, East Las Vegas, writes concerning the advantages of the wall museums which he has used in the department of biology under his care. The cases are shallow, and consist of frame and back of wood, and a glass front screwed down tightly so as to keep out dust. Wall museums of this kind occupy no space needed for other purposes, and can be placed in any rooms continually used by students. A similar plan has been advocated by some teachers in this country, who will be glad to hear of the success which Prof. Cockerell has found to attend the employment of wall cases in his biological instruction.

To be able to attach, by means of an adapter, a telephoto lens to the objective of one's camera is a desideratum which will be appreciated by many photographers. Such an acquisition has recently been placed on the market by Messrs. J. H. Dallmeyer, Ltd., in the form of "the Adon" lens, which is a very compact, light and well-finished article. It is mounted in aluminium, has a rack and pinion adjustment, and an adapter for mounting it on other lenses, or a flange for using it by itself, and an iris diaphram, the whole of which is contained in a neat leather case. The system itself is composed of two achromatic combinations, the front being a positive lens of focal length $4\frac{1}{2}$ inches, and the back a negative lens $2\frac{1}{4}$ inches in focal length. The focusing is manipulated by the rack and pinion, thus obviating the necessity of altering the extension of the camera. When used in front of an ordinary lens, there is a limit to the magnification obtainable, but by itself it has no such limitation; in the first case magnification from 2 to $2\frac{1}{2}$ diameters can be secured. The illustrations contained in the booklet which describes the methods of use and results obtained with this lens show specimens of the kind of work that can be accomplished, and speak well for the definition of the combination.

Mr. F. E. Ives has described in the *Journal of the Franklin Institute* a very simple way of measuring objects under the microscope by projecting an image of an illuminated scale—a jeweller's saw was used on the plane of the object by means of the substage condenser.

The unfortunate controversy that has arisen between Major Ross and Prof. Grassi regarding the discovery of the mosquito phase of the malaria parasite continues, and a lengthy pamphlet dealing with the whole matter has been issued by the last named. To an impartial observer, it would seem that the credit of the discovery must undoubtedly be given to Major Ross, but that a vast amount of detail as to the exact metamorphoses undergone by the parasite and the elucidation of the species of mosquito concerned have been contributed by Prof. Grassi.

As is well known, a high body temperature is incompatible with life, and when it rises to about nine degrees above the normal (from 98°·4 to 107° F.), and continues at this for any length of time death ensues. Drs. Halliburton and Mott show that this temperature coincides with the coagulation of one of the proteids, cell-globulin, of the cells of the nerve-centres, and probably of other cells of the body, and suggest, therefore, that the physico-chemical cause of death from hyperpyrexia is the coagulation of cell-globulin.

It is announced that commencing with the current volume, the *Physical Review* will be conducted with the cooperation of the American Physical Society, and the proceedings of the Society will be published in the *Review* instead of in the *Bulletin* previously issued.

Prof. Luigi Sala publishes in the Lombardy *Rendiconti* an account of the work of Giovanni Zola, professor of anatomy in the University of Pavia, who died on December 15, 1899. Prof. Zola was the author of more than seventy writings dealing with anatomy, his largest work being his description of the museum of human anatomy at Pavia. He was also one of the founders, in 1879, of the *Bollettino scientifico*, which he edited jointly with Profs. A. de Giovanni, of Padua, and Leopoldo Maggi, of Pavia.

In a note contributed to the *Physical Review* on the dimensions of large inductance coils, Mr. James E. Ives gives numerical results showing that a coil of maximum inductance must have a square cross section, that the inductance of a coil with given length of wire increases rapidly as the mean radius is increased up to the maximum inductance, and then decreases slowly, and that for coils of maximum inductance the inductance increases rapidly as the length of wire increases, but not quite proportionately to the square of the length. The second conclusion shows that it is better to make the mean radius too large than too small.

In certain notes on the anatomy of the 9-banded armadillo (*Tatusia novemcincta*), published in vol. xvii. of *Mem. Soc. Antonio-Alzate*, Dr. Duges alludes to the animal under the name of *Cachicama novemcincta*. We have been unable to find that generic term in any list, and if the author intends it to supersede Tatusia (or Tatu, as some would have it), this should have been definitely stated.

In continuation of previous articles on exterminated animals, Mr. G. Renshaw, in the March number of the *Zoologist*, publishes one on the black emeu (*Dromaeus ater*), of Kangaroo Island, which was exterminated by a squatter some time during the last century. A stuffed specimen in the Paris Museum is the only complete skin of this bird known to exist.

Much interest attaches to an article by Mr. E. C. Case in the February number of the *American Naturalist* on the "Pelycosaurian" reptiles of the Permian and Triassic formations of North America. These reptiles were near relatives of the anomodonts (theriodonts and dicynodonts) of the Trias of South Africa and other countries of the Old World. The author now finds that the American forms, in the retention of two temporal arcades to the skull, display affinities to the tuatera (Rhynchocephalia) which are lost in their African allies, the two temporal arcades having in these

latter more or less completely coalesced. We have thus further evidence of the derivation of mammals, firstly through forms allied to the American pelycosaurians, and then through the Old World theriodonts, from the primitive rhynchocephalian type.

Mr. F. Finn has sent us a copy of a paper on variation in birds, reprinted from the *Journal* of the Asiatic Society of Bengal. Among the abnormalities is a five-toed quail; while colour-variations are well illustrated by a plate showing three different phases in the pintail snipe. As regards variation under domestication, the author believes this to be due to conditions favouring the preservation of abnormal individuals rather than to an inherent tendency to vary. Neither, he believes, is climate directly conducive to variation. The coarse and heavy body form noticeable in so many domesticated birds, especially waterfowl, appears to be due to the aggregate result of small tendencies in this direction, which, in the wild state, would have been soon eliminated. Possibly the ultra development of fleshy structures, such as combs and wattles, among many domesticated birds is due to this tendency towards a coarse and heavy habit.

The investigations of Prof. Vines upon the nature of ferments in plants which act upon proteids—on which subject a second paper appears in the *Annals of Botany*—suggest that these are of two kinds. The ferment found in seeds and fruits, notably pineapples and figs, or other storage organs, can break down the more complex proteids, but the digestive substance detected in many leaves, stems and roots can only act upon simpler proteid bodies; this may correspond to the ferment termed *erepsin*, which has been discovered in the small intestine of animals.

Information from the neighbourhood of Newfoundland and Nova Scotia indicates that this is likely to be a great ice season. Before the end of February vessels were already being seriously delayed by extensive ice-fields and floes, and scores of large bergs. In some cases it has been necessary to steam southward for many hours to get clear of the danger. The bergs are met with well to the eastward of the Newfoundland bank, and it will not be surprising if they drift as far as the 40th meridian, or even to 35° W., judging by the welling-up, thus far to the eastward, of the very cold water of an under current which probably comes from the ice region. Round 50° N., 35° W., in December and January last, such exceptionally low sea temperatures as 32° to 40° were observed.

Dust storms and ice are amongst the interesting features of the Meteorological Office pilot chart for the month of April. It is now a comparatively easy matter to explain the fall of dust which was so generally observed over the south of England and in many Continental countries, from the Bay of Biscay to Austria, on February 22–23 last. The meteorological logs from various ships show that since the middle of December immense quantities of sand have been borne by the African harmattan wind over the Gulf of Guinea and out on the Atlantic to about 30° W. longitude. At first the phenomenon was limited to the tropical region, but in February, when we had such a remarkably persistent southerly to south-westerly wind in the British Isles, the north-east trade was displaced by a south-easterly to south-westerly breeze, at least down to the latitude of 13° N. The dust was therefore carried northward by this current, and there are a number of records of falls in various latitudes. On February 21, the day before the fall in Europe, a fine, light reddish dust was deposited on a ship in 40° N., $23\frac{1}{2}$° W., the dust coming up from south-south-west or south-west. There seems to be sufficient evidence available to negative the theory that the dust falls had their origin in the West Indian volcanic outbursts of last year.

Messrs. Charles Griffin and Co., Ltd., have reissued at 6*s*. net the third edition of "A Short Manual of Inorganic Chemistry," by Dr. A. Dupré, F.R.S., and Dr. H. W. Hake.

An eighteenth edition of Trautwine's "Civil Engineer's Pocket-Book" has been published by Messrs. John Wiley and Sons in New York, and Messrs. Chapman and Hall in this country. The new edition is larger by about 100 pages than its recent predecessors. Numerous new articles have been introduced, and about twenty others have been re-written. It is thirty years since the first edition of the pocket-book appeared, and in its new form it should have another long lease of life.

The second part of the second German edition of Prof. J. H. van 't Hoff's "Vorlesungen über theoretische und physikalische Chemie" has been published by Messrs. F. Vieweg and Son, Brunswick. It will be remembered that the work is based upon lectures delivered in the University of Berlin, and contains a clear and concise statement of the principles of physical chemistry. The first part deals with chemical dynamics, and the part before us is concerned with chemical statics. The price of this part is four marks.

The *Berichte* for March 7 contains a very striking paper by Messrs. Bamberger and Seligman on the tertiary nitroso-paraffins. The three compounds described are blue when in a monomolecular state, but, like nitrogen peroxide, readily polymerise to colourless bimolecular compounds. Thus the blue ethereal solutions deposit colourless crystals, and the evaporation of the last trace of ether is accompanied by an abrupt bleaching of the whole mass. The change is, however, by no means instantaneous, and a solution of the white polymer only gradually develops the normal blue tint. By determining at intervals of a few minutes the freezing point of a freshly-prepared solution in benzene, the gradual course of the depolymerisation was followed, and it was found that the decrease of molecular weight, which continued during four hours, exactly corresponded with the development of the blue colour. Depolymerisation takes place most rapidly when the compounds are dissolved in chloroform or benzene, and least rapidly when oxygenated solvents such as ethyl acetate or acetic acid are used. Aqueous solutions become blue very slowly, and even on heating to the boiling point the development of colour is not instantaneous. These results are directly contrary to what has previously been observed with reference to the influence of solvents on the velocity of chemical change, and further investigations should yield important results. The contrast with nitrogen peroxide is further illustrated by the fact that the white and blue compounds differ not only in solubility, but also in smell, the white form being odourless, whilst the blue form has a sharp, pungent smell.

The additions to the Zoological Society's Gardens during the past week include two Chanting Hawks (*Melierax musicus*) from South Africa, presented by Mr. A. W. Guthrie; a Nonpareil Finch (*Cyanospiza ciris*), an Indigo Bird (*Cyanospiza cyanea*) from North America, presented by Miss Anne Ricardo; a Broad-fronted Crocodile (*Osteolaemus tetraspis*) from Nigeria, presented by Mr. C. V. Fox; a Hagenbeck's Mangabey (*Cercocebus hagenbecki*) from the Upper Congo, a Black-handed Spider-Monkey (*Ateles geoffroyi*) from Central America, deposited; eight Mandarin Ducks (*Ex galericulata*) from China, received in exchange.

OUR ASTRONOMICAL COLUMN.

A New Star in Gemini.—A communication received from Prof. H. H. Turner on March 25 announced that the image of a Nova, or a variable, had been discovered on a photograph taken at the University Observatory, Oxford, on March 16. The position of the object was given as

R.A. = 6h. 37m. 48·9s., Dec. = +30° 2′ 39″ (1900),

which is situated in the constellation Gemini near to the border of Auriga, and about half-way between θ and ϵ Geminorum, a little preceding the straight line joining them. This position was confirmed by an observation made at Oxford on the evening of March 24. A telegram from the Kiel Centralstelle confirmed the discovery.

In a second communication from Oxford it was announced that Mr. Newall had observed the spectrum with a direct vision spectroscope attached to the Sheepshanks equatorial at Cambridge, and had little doubt that the object was a Nova. He found that bright lines—both numerous and strong—were present, those in the green part of the spectrum being especially bright.

In a letter to the *Times* of Saturday, March 28, Prof. Turner stated that the object was not bright enough for its image to appear on plates taken on February 24 and earlier, and as no apparent movement had taken place between March 16 and 24, it was certainly not a planet.

The magnitude of the new star is about 7, and, as it is at present near to the zenith during a greater part of the evening, it should be easy to observe, given favourable meteorological conditions. The accompanying chart shows the approximate position of the Nova in regard to the surrounding stars.

A *Circular* (No. 58) from the Kiel Centralstelle announces that Prof. Hartmann, at Potsdam, examined the visual spectrum on March 27. He found the hydrogen lines Hβ and Hα to be present, the latter appearing especially bright; the yellow part of the spectrum is extremely faint as compared with the blue, which contains many bright lines superimposed on a continuous spectrum. The spectrum leads to the conclusion that the star is either a Nova or a variable of the Mira type.

Prof. Hale, at Yerkes Observatory, observed the Nova on March 27·75 (G.M.T.), and found its position to be α = 6h. 37m. 49s., δ = +30° 2′ 38″, and its magnitude 8·5. The spectrum contains bright lines (or bands), and the colour of the Nova is red.

The Solar Constant.—In a paper read before the American Association for the Advancement of Science on December 30, Prof. S. P. Langley discussed the values which have hitherto been obtained for the constant of solar radiation, and gave an outline of the course of study of this constant that it is proposed to carry out in the immediate future at the Smithsonian Astrophysical Observatory.

The author, in his opening remarks, drew attention to the vital importance to humanity of obtaining definite knowledge of the magnitude, nature and possible variations of this radiation, and stated that whilst many other astronomical problems are of great interest from a purely scientific point of view, this one problem is of intensely practical importance; he then summarised this view in the following statement: "I recognise that every nebula might be wiped out of the sky to-night without affecting the price of a labourer's dinner, while a small change in the solar radiation may conceivably cause the deaths of numberless men in an Indian famine."

Thus recognising the grave importance of a minute study of solar physics, Prof. Langley devoted a great deal of attention to its problems whilst connected with the Allegheny Observatory and the Mount Whitney expedition, and with his bolometer made a long series of observations which led to the conclusion that the values obtained by Pouillet and other observers were far too small. By measuring the solar radiations wave-length by wave-length, he obtained values varying from 3·0 to 3·5, thus nearly doubling the classical value, 1·76 calories, obtained by Pouillet.

Using the bolometric method it is now possible to obtain results in fifteen minutes which it previously took two days to obtain, and the Smithsonian Observatory proposes to commence, in the immediate future, a series of observations in order to determine (*a*) the coefficients of atmospheric transmission under all conditions, and (*b*) the coefficients of transmission of the various parts of the apparatus. In doing this the observers will become familiar with the experimental methods which, it is hoped, will be used later at more elevated stations where the atmospheric conditions are much more favourable, and they will also obtain values more nearly approximate to the true values than those hitherto obtained (*Astrophysical Journal*, vol. xvii. No. 2).

The Magnesium Spectrum Line at λ 4481.—Sir William and Lady Huggins communicate to the March number of the *Astrophysical Journal* the preliminary results obtained by them in a series of experiments made in order to determine under what laboratory conditions the line at λ 4481 in the magnesium spectrum assumes the sharp, narrow appearance it has in many stellar spectra.

The authors have arrived at the conclusion that the quantity and the electromotive force of the electricity which acts during the spark discharge between magnesium poles, have only a small influence on the character of this line, but that the suddenness of the blow of the discharge determines its character.

In a plate which accompanies the article is shown a reproduction of the spark spectrum where the discharge of the secondary took place directly between the magnesium poles, the jar having been removed from the circuit; in this case the blow of the discharge is less sudden, through the incoming of the full self-induction of the coil itself, and the line assumes the sharp appearance seen in stellar spectra.

Other spectra which are reproduced show the difference in the appearance of this line under various conditions of spark discharge.

THE EMANATIONS OF RADIUM.[1]

A solution of almost pure radium nitrate which had been used for spectrographic work was evaporated to dryness in a dish, and the crystalline residue examined in a dark room. It was feebly luminous.

A screen of platinocyanide of barium brought near the residue glowed with a green light, the intensity varying with the distance separating them. The phosphorescence disappeared as soon as the screen was removed from the influence of the radium.

A screen of Sidot's hexagonal blende (zinc sulphide), said to be useful for detecting polonium radiations, was almost as luminous as the platinocyanide screen in presence of radium, but there was more residual phosphorescence, lasting from a few minutes to half an hour or more according to the strength and duration of the initial excitement.

The persistence of radio-activity on glass vessels which

[1] By Sir William Crookes, F.R.S. Read at the Royal Society on March 19.

have contained radium is remarkable. Filters, beakers, and dishes used in the laboratory for operations with radium, after having been washed in the usual way, remain radio-active; a piece of blende screen held inside the beaker or other vessel immediately glowing with the presence of radium.

The blende screen itself is sensitive to mechanical shocks. A tap with the tip of a penknife will produce a sudden spark of light, and a scratch with the blade will show itself as an evanescent luminous line.

A diamond crystal brought near the radium nitrate glowed with a pale bluish-green light, as it would in a "Radiant Matter" tube under the influence of kathodic bombardment. On removing the diamond from the radium it ceased to glow, but when laid on the sensitive screen, it produced phosphorescence beneath which lasted some minutes.

During these manipulations the diamond accidentally touched the radium nitrate in the dish, and thus a few imperceptible grains of the radium salt got on to the zinc sulphide screen. The surface was immediately dotted about with brilliant specks of green light, some being a millimetre or more across, although the inducing particles were too small to be detected on the white screen when examined by daylight.

In a dark room, under a microscope with a ⅔-inch objective, each luminous spot is seen to have a dull centre surrounded by a luminous halo extending for some distance around. The dark centre itself appears to shoot out light at intervals in different directions. Outside the halo, the dark surface of the screen scintillates with sparks of light. No two flashes succeed one another on the same spot, but are scattered over the surface, coming and going instantaneously, no movement of translation being seen.

The scintillations are somewhat better seen with a pocket lens magnifying about 20 diameters. They are less visible on the barium platinocyanide than on the zinc sulphide screen.

A powerful electromagnet has no apparent effect on the scintillations, which appear quite unaffected when the current is made or broken, the screen being close to the poles and arranged axially or equatorially.

A solid piece of radium nitrate is slowly brought near the screen. The general phosphorescence of the screen as visible to the naked eye varies according to the distance of the radium from it. On now examining the surface with the pocket lens, the radium being far off and the screen faintly luminous, the scintillating spots are sparsely scattered over the surface. On bringing the radium nearer the screen the scintillations become more numerous and brighter, until when close together the flashes follow each other so quickly that the surface looks like a turbulent luminous sea. When the scintillating points are few there is no residual phosphorescence to be seen, and the sparks succeeding each other appear like stars on a black sky. When, however, the bombardment exceeds a certain intensity, the residual phosphorescent glow spreads over the screen, without, however, interfering with the scintillations.

If the end of a platinum wire which has been dipped in a solution of radium nitrate and dried is brought near the screen, the scintillations become very numerous and energetic, and cease immediately the wire is removed. If, however, the end of the wire touches the screen, a luminous spot is produced which then becomes a centre of activity, and the screen remains alive with scintillations in the neighbourhood of the spot for many weeks afterwards.

"Polonium" basic nitrate produces a similar effect on the screen, but the scintillations are not so numerous.

Microscopic glass, very thin aluminum foil, and thin mica do not stop the general luminosity of the screen from the X-rays, but arrest the scintillations.

I could detect no variation in the scintillations when a rapid blast of air was blown between the screen and the radium salt.

A beam of X-rays from an active tube was passed through a hole in a lead plate on to a blende screen. A luminous spot was produced on the screen, but I could detect no scintillations, only a smooth uniform phosphorescence. A piece of radium salt brought near gave the scintillations as usual, superposed on the fainter phosphorescence caused by the X-rays, and they were not interfered with in any degree by the presence of X-rays falling on the same spot.

During these experiments the fingers soon become soiled with radium, and produce phosphorescence when brought near the screen. On turning the lens to the, apparently, uniformly lighted edge of the screen close to the finger, the scintillations are seen to be closer and more numerous; what to the naked eye appears like a uniform "milky way," under the lens is a multitude of stellar points, flashing over the whole surface. A clean finger does not show any effect, but a touch with a soiled finger is sufficient to confer on it the property. Washing the fingers stops their action.

It was of interest to see if rarefying the air would have any effect on the scintillations. A blende screen was fixed near a flat glass window in a vacuum tube, and a piece of radium salt was attached to an iron rocker, so that the movement of an outside magnet would either bring the radium opposite the screen or draw it away altogether. A microscope gave a good image of the surface of the screen, and in a dark room the scintillations were well seen. No particular difference was observed in a high vacuum; indeed, if anything the sparks appeared a trifle brighter and sharper in air than in vacuo. A duplicate apparatus in air was put close to the one in the vacuum tube, so that the eye could pass rapidly from one to the other, and it was so adjusted that the scintillations were about equal when each was in air. The vacuum apparatus was now exhausted to a very high point, and the appearance on each screen was noticed. Here again I thought the sparks in the vacuum were not quite so bright as in air, and on breaking the capillary tube of the pump, and observing as the air entered, the same impression was left on my mind; but the differences, if any, are very minute, and are scarcely greater than might arise from errors of observation.

It is difficult to form an estimate of the number of flashes of light per second. But with the radium at about 5 cm. off the screen they are barely detectable, not being more than one or two per second. As the distance of the radium diminishes the flashes become more frequent, until at 1 or 2 cm. they are too numerous to count.

[*Added March* 18.—On bringing alternately a Sidot's blende screen and one of barium platinocyanide, face downwards, near a dish of "polonium" sub-nitrate, each became luminous, the blende screen being very little brighter of the two. On testing the two screens over a crucible containing dry radium nitrate, both glowed; in this case the blende screen being much the brighter. Examined with a lens, the light of the blende screen was seen to consist of a mass of scintillations, while that of the platinocyanide screen was a uniform glow, on which the scintillations were much less apparent.

The screens were now turned face upwards so that emanations from the active bodies would have to pass through the thickness of card before reaching the sensitive surface. Placed over the "polonium" neither screen showed any light. Over the radium the platinocyanide screen showed a very luminous disc, corresponding with the opening of the crucible, but the blende disc remained quite dark.

It therefore appears that practically the whole of the luminosity on the blende screen, whether due to radium or "polonium," is occasioned by emanations which will not penetrate card. These are the emanations which cause the scintillations, and the reason why they are distinct on the blende and feeble on the platinocyanide screen is that with the latter the sparks are seen on a luminous ground of general phosphorescence which renders the eye less able to see the scintillations.

Considering how coarse-grained the structure of matter must be to particles forming the emanations from radium, I cannot imagine that their relative penetrative powers depend on difference of size. I attribute the arrest of the scintillating particles to their electrical character, and to the ready way in which they are attracted by the coarser atoms or molecules of matter. I have shown that radium emanations cohere to almost everything with which they come into contact. Bismuth,[1] lead, platinum, thorium uranium, elements of high atomic weight and density, possess this attraction in a high degree, and only lose the emanations very slowly, giving rise to what is known as "induced radio-activity." The emanations so absorbed from radium by bismuth, platinum, and probably other

[1] I have been quite unable to detect any lines but those of bismuth (and of known impurities) in the spectrum of the strongest and most active "polonium" salt I have been able to procure.

bodies, retain the property of producing scintillations on a blende screen, and are non-penetrating].

It seems probable that in these phenomena we are actually witnessing the bombardment of the screen by the electrons[1] hurled off by radium with a velocity of the order of that of light; each scintillation rendering visible the impact of an electron on the screen. Although, at present, I have not been able to form even a rough approximation to the number of electrons hitting the screen in a given time, it is evident that this is not of an order of magnitude inconceivably great. Each electron is rendered apparent only by the enormous extent of lateral disturbance produced by its impact on the sensitive surface, just as individual drops of rain falling on a still pool are not seen as such, but by reason of the splash they make on impact, and the ripples and waves they produce in ever-widening circles.

THE PSYCHOLOGY AND NATURAL DEVELOPMENT OF GEOMETRY.[2]

In connection with recent endeavours to place the teaching of geometry on the best possible basis, much interest attaches to Dr. Mach's attempt to trace the order in which geometrical facts first made themselves known in the natural order of evolution.

The earliest notions of space must have been suggested by the relations of physical bodies to the parts of the human body, the spacial behaviour of bodies towards one another subsequently acquiring a mediate and indirect interest far transcending that of the momentary sensations. While the senses of sight and touch only give rise to sensations of surface, crude physical experience soon impels us to conceive the notion of volume, and the *constancy of volume* of bodies would be one of the first attributes to manifest themselves to our senses. Geometry, although asserted to be concerned with ideal objects only, arose from the consideration of the space relations of physical bodies. The earliest units of measurement were derived from our hands and feet. But the material properties of bodies rather than their spacial properties possess the greatest interest for us, and Dr. Mach considers that the first ideas of measurement were those of volume, and arose from counting the number of equal identical immediately adjacent bodies which would fill a given space. The notion of *areas* would be derived from the number of food-bearing plants which a given field would contain or the labour required in planting them, *distance* would be estimated by hours of travel. The measurement of lines and areas by means of *solids* is a notion now completely estranged from our geometrical ideas, but in early times we should have measured lengths and areas by the number of solid bodies placed in line or distributed over a surface required to cover them, an idea which is borne out by the remarkably elegant methods of mensuration expounded in the seventeenth century by Cavalieri.

Although movable bodies present different spacial sensations to the visual sense dependent on the position and distance of the observer, the notion of spacial constancy becomes associated with them both by the sense of touch and by combined experience.

The earliest conceptions of *purely spacial* properties naturally asserted themselves in the pursuit of trades and arts. The property that a number of equal and similar triangles of any shape can be fitted together in regular order to form a pavement or mosaic naturally leads to the property that the three angles of a triangle are together equal to a straight angle. A consideration of the way in which the triangles run in rows would lead to the notion of parallels, and the property that the adjacent angles made by the parallel lines with any transversal are together equal to two right angles. The theorem of the Pythagoreans, according to which superficial space can only be partitioned into regular polygons in three ways, namely, into equilateral triangles, squares, or hexagons, naturally finds its origin in the same source.

[1] Radiant matter, satellites, corpuscles, nuclei; whatever they are, they act like material masses.

[2] Abstract of a paper by Dr. E. Mach in the *Monist*. Translated by T. J. McCormack.

A stretched string furnishes the simplest visualisation of a straight line, and leads to the property that a straight line is the shortest distance between two points, but Dr. Mach reminds us that this property cannot be regarded as being established by mere visualisation. It is true that we have learnt instinctively to reproduce in our imagination some method of demonstrating that, for example, two sides of a triangle are greater than the third side, but the source of our knowledge here is *physical experience* derived from our knowledge of material bodies. Another property of straight lines, namely, that a straight line is self-congruent if made to slide or rotate upon itself, is also a result of experience with straight and bent wires.

The knowledge that the measures of geometry depend on one another was reached in divers ways. The division of a parallelogrammatic field into smaller fields gave rise to the area being measured by the product of the length and breadth, and the knowledge that the area of a rectangle is greater than that of a parallelogram having the same sides gave rise to the idea that the area also depended on the angles.

In regard to *angles*, Dr. Mach points out that the definition of an angle as the difference between two directions is a *physiological* definition, the notion of direction being a purely physiological conception. In *abstract space*, obtained by metrical experiences with physical objects, differences of direction do not exist. An angle is determined when the distance is assigned between two points on its arm at given distances from the vertex, but, as Dr. Mach points out, this measure, though closely resembling those adopted in trigonometry, was not used in geometry, because angles so measured would not possess *additive* properties. The simpler measure of an angle by the arc or area which it intercepts on a circle surrounding the vertex thus became generally adopted. In connection with Dr Mach's views on this point, it may be maintained that even with our present experience of geometry an angle instinctively suggests the idea of *space*, extending, no doubt, indefinitely from the vertex, but possessing the remarkable property of being a definite fraction of the whole space surrounding that point.

The object of geometry is to answer questions that occur repeatedly in the same form, and with this object has arisen the study of deductive geometry, which takes theorems and proves them once for all. But it will be seen that Dr. Mach strongly emphasises the *physical* and *material origin* of geometry, and his studies will naturally support the view that geometry is likely to be best understood when taught in its early stages from the experimental side.

THE EUCALYPTS.[1]

The economic importance of the genus Eucalyptus to our Australian Colonies accounts, no doubt, for the somewhat extensive official literature which has grown up there on this subject. This includes numerous publications by the Government botanists and forest officials of the Australian colonies, and especially the classic "Eucalyptographia," now, unfortunately, no longer obtainable, of the late Baron von Mueller, whose enthusiasm for the genus is mainly responsible for the large Eucalyptus plantations now existing in Italy, France, Algeria, California and other countries.

Messrs. Baker and Smith, in their contribution to Eucalyptus literature, give an account of the results they have secured in the course of a systematic study of the Eucalypts, both from the botanical and chemical points of view, and they conclude from the data so obtained that the trees belonging to this genus may be divided into a series of natural groups, in which there is a striking correlation between the structure of the leaves, and to a certain extent, also, of the barks, and the composition of the essential oils produced by the species; thus, in *Eucalyptus tesselaris*, which the authors regard as the primitive type, the leaves have a characteristic parallel lateral venation and furnish

[1] "A Research on the Eucalypts especially in regard to their Essential Oils." By R. T. Baker, F.L.S., and H. G. Smith, F.C.S. Pp. 295; with o plates. (Technological Museum: New South Wales.)

"Eucalypts Cultivated in the United States." By A. J. McClatchie, M.A. Pp. 101; with 91 plates. (Department of Agriculture, U.S.A.)

an oil consisting principally of pinene; this is also the case with about thirteen other species, which together form Group I. in this system of classification. In the succeeding groups, the lateral venation of the leaves becomes gradually more complex, a marginal vein appears, and at the same time the oils produced undergo what may be called a corresponding change; thus pinene is partially replaced by cineol, until, as in the *Eucalyptus globulus*, which the authors appear to regard, probably in deference to its commercial value, as the highest evolutionary product of the genus, this constituent amounts to 60 per cent. of the oil obtained. In the course of this evolution there have appeared several side issues furnishing oils in which cineol is replaced by aromadendral, piperitone, geranyl acetate or citronellal and pinene, wholly or partially by the terpene phellandrene, and in each of these groups, also, there exists a corresponding leaf structure.

Interesting as is this correlation of morphology and constituents in the Eucalyptus species, it may be pointed out that a knowledge of the constituents of a plant is never likely to play such an important part in systematic botany as the authors appear to believe, since there are already known numerous instances of plants which, grown under different climatic conditions, show no morphological change, yet exhibit remarkable variation in constituents, and, on the other hand, plants which are not at all closely related, frequently contain the same colouring matters, alkaloids, &c., so that the necessary specific constancy of constituents, which alone would make such criteria useful, is wanting. The authors lay stress on observations made by them as to the absence of marked variation in the composition of oils yielded by the same Eucalyptus species grown in different districts of Australia, but the evidence of constancy in this respect would be greatly strengthened if it could be shown to hold for the same species grown outside Australia; for an investigation of this kind ample material now exists in foreign plantations.

The principal feature of the volume is, however, the publication of results obtained in the examination of the oils yielded by practically all the Eucalyptus species indigenous to Australia. A short description of the oil obtained, with its physical constants and those of its principal fractions, is appended to the botanical description of each species, and in order to render these more readily available, they are tabulated in special appendices.

The evidence adduced by the authors of the occurrence in the Eucalyptus oils examined of the normal constituents cineol, pinene, phellandrene, &c., is, as a rule, unexceptionable, but occasionally there are lapses which perhaps are due more to the magnitude of the authors' task in recording such a mass of facts than to their lack of scientific thoroughness, *e.g.* a minute difference in the lævorotation of two fractions seems insufficient evidence for the assumption that aromadendral exists in the oil of *E. corymbosa* (p. 26); similarly, the coincidence of the melting point of the nitrosochloride of the terpene of *E. botryoides* with that of pinene nitrosochloride is not conclusive evidence of the presence therein of pinene, and it is usual in such a case to prepare in addition the nitrol-piperide or similar derivative. The evidence given for the occurrence of a valeric acid ester in *E. umbra* (p. 37) is worthless, whilst the lemon-like odour of a particular fraction of the oil of *E. fraxinoides* scarcely warrants the assumption that it is due to citral without characterisation of this aldehyde by the preparation of at least one of its readily obtained derivatives. The authors also appear to be unaware that the reaction (p. 235) which they employ for the identification of geraniol, viz. its oxidation to citral by chromic acid, is equally well given by the isomeride linalool. The formation of an alcohol (cineol) of the composition $C_{10}H_{18}O$ (p. 223) by the oxidation of an aldehyde (aromadendral) of the composition $C_{10}H_{14}O$ is, if it really occurs—and on this point the evidence is slender—a unique reaction, and requires further investigation. It seems unfortunate, also, that whilst the specific rotation and solubility of the oils have invariably been determined, the authors did not utilise their unique opportunity to record such useful constants as the refractive index and dispersion. Exception must also be taken to the use of the name eucalyptol in place of cineol in a scientific publication of this kind.

The volume, as a whole, is remarkably well printed, and the plates depicting leaves of the typical groups clearly exhibit the characteristic features to which attention is drawn in the text.

The mere collection of the material necessary for an elaborate investigation of this kind is a task of considerable magnitude, and when there is added to this the tedious experimental work involved in the investigation of a large number of oils of similar composition, some idea may be obtained of the industry and perseverance the authors have expended on this work. The results should be of inestimable advantage to the colony far-sighted enough to encourage the prosecution of such investigations.

The American volume is intended primarily to enable forest proprietors to identify the Eucalyptus species in their possession, and is therefore largely a compilation of the diagnostic characters of the fifty odd species which have been introduced into the south-western States. The author, however, devotes some space to extolling the ornamental and useful character of these trees, and points out their value, particularly as wind breaks, shade trees, improvers of climate and as sources of timber and essential oil. The virtues of the latter, when of American origin, are described in language somewhat reminiscent of the advertisements of transpontine proprietary medicines. The chemistry of the volume is occasionally at fault, as, for instance, when it is stated that (p. 13) "the exudations from the trees are in most cases *not* gums, but resins," and "the chief ingredient of the lemon-scented Eucalypt is *citronellon*" (p. 39). The volume is, like most of the publications of the U.S. Department of Agriculture, well printed and copiously provided with useful and artistic illustrations.

T. A. HENRY.

OPPOSITION OF MARS.

MARS is now brightly visible during the whole night, and well placed in the sky for observation. He occupies a position on the equator in Virgo, but the present apparition is not really a favourable one, the distance of Mars from the earth on the date of opposition (March 28) being nearly sixty millions of miles. The apparent diameter of the planet, as given in the *Nautical Almanac*, will be $14''\cdot6$; this is only half the value ($29''\cdot5$) which the planet presented in the best circumstances in August, 1892, and September, 1877. At those periods, however, the declination of Mars was more than 24° south of the equator, so that telescopic observations were rendered very difficult at stations in high northern latitudes. A comparison of the last few oppositions of this planet gives the following figures:—

Opposition.		h.	Apparent Diameter. ″	Declination. ° ′	Distance. Millions of Miles.
1894, October	20	10	25·6	+ 8 32	40
1896, December	10	18	16·6	+25 39	52
1899, January	18	12	14·4	+24 42	61
1901, February	21	18	13·8	+14 36	63
1903, March	28	20	14·6	− 0 7	60

Though the conditions under which Mars is now displayed compare unfavourably with those at a really good opposition, it is quite possible to distinguish a large amount of detail on the disc. The principal features are very dark and well pronounced, and may all be recognised under pretty high powers. Fortunately, Mars satisfactorily bears more extreme magnification than Jupiter. In studying the latter object with a 10-inch reflecting telescope, the writer has found a power of 252 very efficient and 312 ample for every purpose, but on Mars the most serviceable powers appear to be from 332 to 488.

The study of Mars is essentially different in character from that of Jupiter. The latter does not exhibit his real disc, but a series of vaporous, longitudinal currents, in which are floating a number of changing spots of various tints. Mars shows real surface markings, which appear subject to certain temporary differences due to atmospheric interference. In fact, the aim of an observer of Mars is to distinguish the outlines of the markings in a comprehensive

manner, as regards both their positions and forms, while the student of Jupiter occupies himself in taking transits of the various spots visible in order to ascertain the rotation periods of objects situated in different latitudes. The rotation period of Mars is much more exactly known than that of any other planet (the earth excepted), and Prof. Bakhuyzen's value for this is 24h. 37m. 22·66s., deduced from 220 years' observations.

It seems desirable to note the accurate times when certain well-defined objects on Mars cross the central meridian in order to test the correctness of the ephemeris (*Monthly Notices*, June, 1902). Such transits will be most precisely obtained by micrometrical measurement. The particular forms, relative prominence and positions of the various dark and bright markings require further careful record, and must always be regarded as the most important aims in the observational study of this object. A large number of excellent charts of Mars have been published affording a useful means of comparison, but the observer need feel no disappointment should he fail to discern the supposed double canals, the oases, or the thick network of interlacing lines which eminently distinguish some of the drawings and impart a very singular aspect to Martian topography. With the planet's diameter apparently very small, as at present, no observer can expect to secure comprehensive views of detail.

For obvious reasons the transit times of spots on Mars cannot be determined with the same accuracy as those of Jovian markings. The small disc of Mars, and its comparatively slow rate of axial motion, are responsible for this. In one hour rotation carries the surface of Mars through only 14°·62, whereas on Jupiter the value is 36°·7. At intervals of about forty days the various features on Mars are presented at nearly the same times as before. Early in March that conspicuous marking known as *Syrtis Major* was favourably displayed in the evenings, and it will be similarly well seen near the middle of April.

W. F. Denning.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Dr. Alexander Paine, of the Jenner Institute, has been appointed lecturer in bacteriology at the Bedford College for Women.

Dr. Bleibtreu, of Bonn, has been appointed to the chair of physiology at the University of Greifswald in succession to the late Prof. Landois.

The authorities of the Clark University, Worcester, Mass., have arranged again this year to hold a summer school from July 13–July 25, where university students, teachers, lecturers in pedagogy, and others may take courses of work in psychology, biology, pedagogy, and anthropology. The lectures and demonstrations will be under the direct supervision of President G. Stanley Hall and other professors of the University.

A telegram through Laffan's Agency from New York, dated March 28, states that Mr. Carnegie has presented an additional 310,000*l*. to the Carnegie Institution at Pittsburg, bringing up his total donations towards the cost of the buildings and their endowment to 1,570,000*l*., exclusive of the 400,000*l*. given for branch libraries of the institution, for fossil excavations in Wyoming, and for other purposes. In addition to this, Mr. Carnegie has promised from 600,000*l*. to 1,000,000*l*. for a new technical institute.

In a recent paper read before the Society of Arts on "Education in the Netherlands," Mr. J. C. Medd remarks that in Holland "few things in recent years have been more striking than the development in nature-study. It is taught universally in schools of every grade, urban and rural, for its great educational value in developing certain faculties, especially those of observation, quite apart from its value as a preparation for science, or in its possible relation to rural pursuits. . . . Text-books are seldom used. Plants and flowers, gathered by the children themselves, are studied objectively, and their structure explained."

The calendar for the session 1902–3 of the University College of Sheffield provides numerous interesting facts concerning the work of the college. For instance, the new endowment fund started in 1895, and the scheme of which was later enlarged when, in 1897, the original Firth College was constituted by Royal Charter a university college, has now reached about 42,000*l*. The calendar shows that the scattered and inadequate nature of the buildings has long been a serious hindrance to the college. Funds have been raised towards the erection of new buildings on a single site for the whole college, and it is hoped a beginning will be made during the current session. Further donations for this purpose are much needed.

The first volume of the report of the U.S. Commissioner of Education for the year 1900-1901 contains, as usual, a great wealth of material for the student of educational problems. It is impossible here even to enumerate the articles contained in the 1216 pages which the volume contains. Among those of more immediate interest to readers of Nature may be mentioned the Commissioner's introduction; the review of education in Central Europe—in which due prominence is given to university and technical education; the account of the International Association for the Advancement of Science, Arts, and Education; the address of the director of the U.S. Geological Survey on the relations of the national Government to higher education and research; the Carnegie Institution of Washington, with a list of the most notable gifts of money by Mr. Carnegie for libraries and other educational purposes—this list shows that Mr. Carnegie has given away in this manner more than thirteen millions sterling; and the chapter on higher commercial education. There can be no doubt the Bureau of Education is not only assisting American education by the issue of these reports, but that of all the great countries of the world.

The retirement of Sir William Abney from the principal assistant-secretaryship of the Board of Education, South Kensington, was marked on Tuesday by the presentation to Lady Abney of his bust in bronze, the work of Prof. Lautéri. Sir John Gorst made the presentation, and in the course of his remarks he referred to the great influence Sir William Abney has exerted upon educational progress in this country. The bronze bust presented to Lady Abney is a token of the esteem in which Sir William Abney is held by his colleagues and a mark of regret at his retirement. The valuable work now being done in schools of science owes its initiative almost entirely to Sir William Abney, who is responsible for the development of scientific instruction in schools since he took charge of the work of the old Department of Science and Art. With a man like Sir Wiliam Abney at the head of affairs, proper provision was secured for the study of science in schools under his control, and the work of these schools has forced other secondary schools to find a place in the curriculum for rational scientific instruction. It is impossible to estimate the great influence which Sir William Abney has thus exerted upon scientific education in this country, but all who know his work understand that his retirement deprives science of one who has always promoted her educational interests.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 5.—"The Electrical Conductivity of Solutions at the Freezing Point of Water." By W. C. D. **Whetham**, F.R.S.

The paper contains an account of experiments which bring to greater concentrations a series of measurements on the conductivities of dilute solutions at the freezing point, communicated to the Royal Society in February, 1900.

The earlier experiments were conducted in a platinum cell, with the object of eliminating any solvent action of glass. Any such action would be quite inappreciable at the concentrations used in the experiments now to be described; resistance cells of glass were consequently used, and the labour of observation was much reduced.

The measurement of the electrical resistance was performed exactly as in the earlier set of experiments. The current from one or two dry cells was alternated by means

of a revolving commutator, which was driven by a hand wheel and cord, the connections of a D'Arsonval galvanometer being simultaneously alternated by the same instrument. The alternating currents were passed through a Wheatstone bridge, in one of the arms of which was inserted the electrolytic cell.

In order to obtain the most probable results for the ratio of the equivalent conductivities to their values at infinite dilution, curves were drawn on squared paper between $m^{\frac{1}{3}}$ and k/m, and the smoothed readings taken at the required places. It is usual to call this ratio the coefficient of ionisation, but at the high concentrations here dealt with, we cannot assume that it really gives the fraction of the number of the molecules which is at any moment ionised; in the light of probable changes in the ionic fluidity of the liquids, and of the possible existence of complex ions, such an assumption is clearly unjustified. For the sake of convenience, the results previously obtained, as well as those of the experiments now described, are tabulated as the equivalent conductivities at 0° referred to the limiting value as unity.

In the earlier set of experiments, approximate values only were obtained for the absolute equivalent conductivities. From the values of the constants of the glass cells now used, it is possible to calculate throughout the whole range of concentration of both sets of observations the exact equivalent conductivities of the salts investigated.

Geological Society, March 11.—Prof. Charles Lapworth, F.R.S., president, in the chair.—Petrological notes on rocks from Southern Abyssinia, collected by Dr. Reginald Kœttlitz, by Dr. Catherine A. **Raisin.** The specimens were collected on an expedition (in 1898–99) starting from Berbera, westward through Somaliland and Southern Abyssinia, and turning northward to the Blue Nile. The crystalline rocks include granite, gneiss, and hornblende-schist or foliated diorite, together with more basic types. Some of the gneisses exhibit pressure effects. The more basic types include diabase, hornblende-gabbro, and one lustre-mottled hornblende-pyroxenite, resembling a picrite. The sandstones (chiefly from Somaliland and the south-east of Abyssinia) are sometimes compacted into quartzites, and are often ferruginous. Some of the limestones are concretionary, others dolomitic, and several from different localities are fossiliferous, containing at Jigjiga Pass Turritella in great numbers. The volcanic rocks include one which is practically a limburgite, many basalts, various less basic volcanic rocks and several pumiceous tuffs. But the most interesting are the phonolites and allied rocks, containing nepheline, riebeckite, or other alkaline minerals. The specimens here described may form a connecting-link between the volcanic rocks of other East African localities.—The overthrust Torridonian Rocks of the Isle of Rum and the associated gneisses, by Mr. Alfred **Harker,** F.R.S. The chief conclusions which the author wishes to establish are:—(1) That the highly disturbed region of the north-west Highlands, already known to extend into the south-eastern part of Skye, is further prolonged into the Isle of Rum. (2) That at numerous places along the disturbed belt which borders the principal mountain-group of the island, the Tertiary plutonic intrusions assume the character of well-banded gneisses, comprising alternations of different lithological types. (3) That these complex gneisses were formed mainly by fluxion in a heterogeneous mass, the heterogeneity being due to the inclusion and incorporation in a granitic magma of relics of ultrabasic and basic rocks.

Zoological Society, March 17.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Mr. Oldfield **Thomas** exhibited the skin of a monkey from Kwei-chow, China, which appeared to represent a new species of Rhinopithecus. Mr. Thomas also exhibited adult and young examples of a new bush-duiker from British East Africa, which he proposed to call *Cephalophus ignifer*.—Mr. J. T. **Cunningham** read a paper in which were described experiments he had made on two cocks of the long-tailed Japanese fowls in his possession, to ascertain what effect the artificial treatment asserted by some to be practised by the Japanese fanciers would have. The two birds had been hatched on the same date, January 13, 1901. One of the birds was left to nature, except that the tail was tied up in paper when the bird was at liberty, to keep the feathers from injury. In this bird the longest feather was 2 feet 4½ inches in length in 1902, and growth ceased in March, and the feathers were moulted normally in the following autumn. In the other bird the feathers were stroked every day between the finger and thumb, so as to pull slightly on the roots. In this specimen growth continued until the middle of July, and a length of more than 2 feet 9 inches was attained in some of the feathers of the first adult plumage. The author considered still more important the fact that ten of the feathers came out under the treatment, and that successors to these immediately grew again, and continued to grow through and beyond the following moulting season. The author concluded that the great length of feather and suppression of the moult were produced by the Japanese fanciers in the same way, by thus stimulating the feathers and extracting them when or before they had completed their growth.—A communication was read from Sir Charles **Eliot,** K.C.M.G., in which two new genera (Ceratophyllidia and Pleurophyllidiella) and five new species were described, and notes given on some already known forms.—Mr. W. P. **Pycraft** read a paper on the osteology of the Cuculiformes = Cuculidæ + Musophagidæ, in which he showed that the isolated position which this suborder held among the Coraciomorphæ was as evident from a study of the osteology of the group as from other points of view.

Manchester.

Literary and Philosophical Society, March 17.—Mr. Charles Bailey, president, in the chair.—Mr. J. Cosmo **Melvill** exhibited two letters written by Linnæus which had recently been rediscovered after being missing for more than eighty years, together with a Wedgwood plaque of Linnæus, given to him by Sir Joseph Hooker, with the information that it had been pronounced by Dr. Solander to be "a better likeness of his master than any ever painted."—Prof. W. Boyd **Dawkins** exhibited a series of mammalian remains from a cavern at Doveholes, near Buxton. He said that the remains belonged to the Pliocene age, and that this was the only cave in Europe which had yielded remains of that period.

Paris.

Academy of Sciences, March 25.—M. Albert Gaudry[1] the chair.—On Abelian functions with complex multiplication, by M. G. **Humbert.**—A study of the combination of carbonic acid with potassium hydride, by M. Henri **Moissan.** The formation of potassium formate from potassium hydride and carbon dioxide has been indicated in a previous paper; it is now shown that the presence of a trace of moisture plays an important part in this synthesis. With perfectly dried materials, there is no reaction under a temperature of 54° C., but the amount of water vapour given off by ice at −85° C. is sufficient to start the reaction, and in presence of moisture the reaction is practically independent of the temperature.—On the physiological causes which determine the constitution of the mollusc type, by MM. Edmond **Perrier** and Ch. **Gravier.**—On the seat and the nature of the hypnagogic images, by M. Yves **Delage.** The question as to whether the hypnagogic images are retinal or cerebral has been much discussed; the author proposes a simple criterion; these images are retinal if they follow the movements of the eyes, or cerebral if they do not. From an experimental study the conclusion is drawn that the former is the case.—On waves in the midst of a vitreous medium affected with viscosity ano very slightly deformed, by M. P. **Duhem.**—On a new kind of light, by M. R. **Blondlot.** It has been shown in previous papers that the radiation from a focus tube, filtered from light rays by passing through a thin sheet of aluminium or black paper, proves to be polarised when examined with a small spark, and the plane of polarisation is rotated by quartz or sugar. It has now been found that a rotation of the plane is also produced when the rays are passed through a Reusch mica pile. A single sheet of mica produces elliptical polarisation, thus indicating that these rays are liable to double refraction. But if this is the case, there should also be simple refraction. Using a small spark as detector, the refraction of these rays by a prism was clearly made out, and an attempt to concentrate the rays by means of a quartz lens was also successful. These effects cannot be due to the X-rays, since the latter undergo neither refraction nor reflection. These results indicate the existence of a new set of radiations

emitted by a Rontgen tube; these rays pass through aluminium, paper, wood, are rectilinearly polarised on their emission, are susceptible of both rotatory and elliptical polarisation, can be reflected and refracted, but produce neither fluorescence nor photographic action.—The catalytic decomposition of ethyl alcohol by finely divided metals: the regular formation of aldehyde, by MM. Paul **Sabatier** and J. B. **Senderens.** The action of reduced copper, nickel, cobalt, and platinum upon alcohol has been studied at varying temperatures. With copper at about 300° C. the alcohol is split up into hydrogen and aldehyde without any secondary reactions. With the other metals the primary reaction would appear to be the same, but the aldehyde is attacked, methane and carbon monoxide accompanying the hydrogen.—On the spectrum of the comet 1902 *b*, by M. A. **de la Baume-Pluvinel.** Owing to the very feeble luminosity of the comet a special arrangement of apparatus was required in order to obtain a photograph of the spectrum, but a negative was finally obtained on October 24 sufficiently good for measurements to be taken. The wave-lengths found are referred to the carbon spectrum, hydrocarbon and cyanogen.—Propagation in conducting media, by M. Marcel **Brillouin.**—On the sub-salts of barium, by M. **Guntz.** By fusing the haloid salts of barium with sodium, compounds of the formula BaXNaX, where X represents the halogen, were obtained. Heated in a vacuum at 700° C., sodium is volatilised and the ordinary barium salt is left.—On methylmonobromocamphor, bromomethylcamphor and methylene-camphor, by M. J. **Minguin.**—On the hydration of the acetylene acids. A new method for the synthesis of non-substituted β-ketonic esters and acids, by MM. Ch. **Moureu** and R. **Delange.** The ordinary method of adding water to acetylene compounds by means of sulphuric acid or mercuric salts having given poor results, caustic alkalies were used with satisfactory results. A description is given of the preparation and properties of several ketonic acids synthesised in this way.—The action of phosphorus trichloride upon glycol, by M. P. **Carré.** The chief product is a compound $P_2.(O.CH_2)_4Cl_2$, the decomposition products of which with water have been studied.—The action of mixed organo-magnesium compounds on bodies containing nitrogen, by M. Louis **Meunier.** Ammonia with ethyl-magnesium iodide gives ethane and $NH_2.MgI$, and aniline, diazoamidobenzene and phenylhydrazine give analogous products.—On the pyrogallol-sulphonic acids, by M. Marcel **Delage.**—Remarks on the soluble ferments which determine the hydrolysis of polysaccharides, by M. Em. **Bourquelot.** The number of soluble ferments or enzymes is greater than is usually supposed; the intervention of the enzymes in the natural phenomena of hydrolysis is governed by relatively simple laws.—The existence of glycerine in normal blood, by M. Maurice **Nicloux.** By applying the method of estimation described in a previous note the author has been able to prove the existence of glycerine in normal blood in very small proportion.—On the mechanism of lipolytic actions, by M. Henri **Pottevin.**—A contribution to the study of the Diplozoa, by M. P. A. **Dangeard.**—On the existence and extension of the pith in the petiole of Phanerogams, by M. **Bouygues.**—On the origin of leaves and on the foliar origin of the stem, by M. Léon **Flot.**—On the dust which fell on February 22, by M. A. B. **Chauveau.** The dust probably came from the Sahara.—Remarks by M. **Mascart** on the preceding note.—On the physiology of the internal ear, by M. **Marage.** A reply to a note of M. Pierre Bonnier.—Experimental researches on the psychophysiology of sleep, by MM. N. **Vaschide** and Cl. **Vurpas.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 2.

LINNEAN SOCIETY, at 8.—List of Marine Algæ collected at the Maldive and Laccadive Islands by J. Stanley Gardiner: Mrs. Gepp (Ethel S. Barton).—The Comparative Anatomy of Cyatheaceæ and other Ferns: D. T Gwynne-Vaughan.

CHEMICAL SOCIETY, at 8.—On the Absorption Spectra of Nitric Acid in Various States of Concentration: W. N. Hartley.—The Dioximes of Camphorquinone and Other Derivatives of *iso*Nitrosocamphor: M. O. Forster.—Salts of a Mercaptoid Isomeric Form of Thioallophanic Acid, and a New Synthesis of Iminocarbammethioalkyls: A. E. Dixon.—Discoloured Rain: E. G. Clayton.—Derivatives of *o*-Aminobenzophenone and *p*-Aminobenzophenone: F. D. Chattaway.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Geographical Education; with Special Reference to Globular Contoured Maps, Globes and Reliefs: Prof. E. Reclus.

RÖNTGEN SOCIETY, at 8.30.—Some Effects produced by Radiations: J. H. Gardiner.

FRIDAY, APRIL 3.

MALACOLOGICAL SOCIETY, at 8.—Additions to the genus Streptaxis: G. K Gude.—On a New Species of the genus Xylopbaga from the English Coast: E. A. Smith.—Notes on some New or Little Known Members of the Family Dorididæ: Sir Charles Eliot.—On a New Species of Cerastus from near Aden, with a Note on *Otopoma clausum*, Sby.: E. R Sykes.—Descriptions of Two Supposed New Species of Cyathopoma: H. B. Preston.—On Shells Floating on the Surface of the Sea: August Krogh.

ROYAL INSTITUTION, at 9.—Drops and Surface Tension: Lord Rayleigh.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of North Staffordshire (with Special Reference to the Whitsuntide Excursion): Dr. Wheelton Hind.—Coal Measures of North Staffordshire: Walcot Gibson.

SATURDAY, APRIL 4

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY APRIL 6

VICTORIA INSTITUTE, at 4.30.—Modern Theories concerning the Composition of Holy Scripture: Rev. John Tuckwell.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Manufacture of Iodine from Nitrate Liquors: Dr. W. Newton.—New Modification of Coffignier's Prussian Blue Reaction, and a possible Application: Watson Smith.—The Explosion of Potassium Chlorate at St. Helen's: Dr. A. Dupré, F.R.S.

TUESDAY, APRIL 7.

INSTITUTION OF CIVIL ENGINEERS, at 8.—American Locomotive Practice: P. J. Cowan.

WEDNESDAY, APRIL 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Rotation Period of the Markings on Jupiter: W. F. Denning—Standard Scale for Telescopic Observation: Percival Lowell.—The Madras Observatory and its Work: Prof. Michie Smith.

GEOLOGICAL SOCIETY at 8.—On the Probable Source of the Pebbles of the Triassic Pebble-Beds of South Devon and of the Midland Counties: O. A. Shrubsole.—Note on the Occurrence of Keisley Limestone-Pebbles in the Red Sandstone-Rocks of Peel (Isle of Man): E. Leonard Gill.

CONTENTS.

THURSDAY, APRIL 9, 1903.

THE CORRESPONDENCE OF CHARLES DARWIN.

More Letters of Charles Darwin. A Record of his Work in a Series of hitherto Unpublished Letters. Edited by Francis Darwin, Fellow of Christ's College, and A. L. Seward, Fellow of Emmanuel College, Cambridge. In two volumes, illustrated. Vol. i., pp. xxiv + 494; vol. ii., pp. viii + 508. (London: J. Murray, 1903.) Price 32s. net.

WE close most biographies with the exclamation "too long and far too many letters," but the three volumes of the "Life and Letters of Charles Darwin," published in 1887, left their readers, like young Oliver Twist, "asking for more." At that time considerations of space and other reasons prevented the editors from publishing numerous letters in their possession, and since then many of great interest have been received. From this unused material they have compiled, with only a few slight repetitions, "an almost complete record of Darwin's work," which will be welcomed, we are sure, not only by students of science, but also by all interested in the history of the Earth and Man. It is now nearly forty-four years since the "Origin of Species" was first published. The book was received with objurgation by the many, with praise by the few, yet in about half that time it had forced its way to a front place among the classics of scientific literature, and though opinions still differ about the prime factor in producing a species, a place is assured to Charles Darwin among naturalists similar to that of Isaac Newton among physical mathematicians. The former, indeed, has effected, outside his own field, an even more rapid and extensive transformation of thought. The idea of evolution has acted like a solvent in subjects to which it might have been supposed alien, for it has even won recognition from theology, by the partisans of which it was at first so vociferously and ignorantly assailed. It has, in short, succeeded in revealing the "How" of the natural order, though making no pretence of fathoming the mystery of the "Why."

The "Life and Letters" contained an autobiographical sketch written in Darwin's later years for the information of his children. When the family removed from the old home at Down, they discovered a fragment of another—dated so long ago as 1838—which is included in the present work. This has a special value as containing fuller and clearer reminiscences of his childhood—information which is always welcome to the students of human nature, for the child in so many respects is the father of the man. From his earliest days Darwin was a collector of curiosities—seeking for minerals and stones before he was nine years old—and was always anxious to understand their structures and significance. He was not, however, quite a pattern good boy, for he confesses to flying into passions and often telling fibs These, however, were not to get him out of scrapes, but simply results of indulging a too vivid imagination, with the desire to astonish the hearers. The tenor of his letters and the devotion of his family circle prove beyond question how effectively he overcame the former fault, and his writings would almost lead us to think the latter incredible, for they show conscientious accuracy to have been one of his most marked characteristics. But it proved him to possess the imaginative faculty, without which perhaps no great generalisation has ever been made. Pegasus, indeed, must be ridden with a curb, but that steed alone can carry its rider across the bounds of space and time.

The present volumes pass briefly over school days at Shrewsbury, the short residence at Edinburgh, and the undergraduate life at Cambridge, where a friendship with Prof. Henslow proved the turning point of his career. Some half-dozen letters, written during his voyage on the *Beagle*—every one well worth preservation—are now printed for the first time, and two or three relating to his marriage and settling at Down. One, addressed to his *fiancée*, shows what the wives of scientific men have often to endure, for he confesses that Charles Lyell and he had been talking "unsophisticated geology" for half an hour, with "poor Mrs. Lyell sitting by a monument of patience," adding that he wants practice in ill-treating the female sex, for he did not observe Lyell had any compunction; "I hope to harden my conscience in time; few husbands seem to find it difficult to do this." But what he owed to this marriage we learn by an extract from his autobiography, which, now that Mrs. Darwin has passed away, is very rightly printed in the present work, for it shows what true and deep feeling lay beneath that calm exterior.

The period between his settling at Down and writing the "Origin of Species" is covered by fifty-eight letters, addressed chiefly to Huxley and Hooker, his most intimate friends. They form a very interesting addition to those already published in the second volume of the "Life and Letters," and throw further light upon the incubation of the idea which was to bring order out of a scientific chaos. Its publication was accelerated, as is well known, by the receipt of a manuscript from Dr. A. R. Wallace, proving that the conception which Darwin had been laboriously working out for some years had dawned upon the former during his researches in the Malay Archipelago. No circumstances could have offered a more favourable opportunity for a wrangle about priority; they proved the nobility of both men's natures by cementing their friendship, and a correspondence discussing topics arising from the "Origin of Species" is not the least interesting part of the present work. With the appearance of the "Origin," the letters become more varied and the writers more numerous; points had to be defended or developed, and new facts sought in corroboration. To all thoughtful objectors Darwin replied with courtesy and candour; of ignorant vituperation he took no note, except sometimes to lament, if it were the ill-considered utterance of a fellow-student in science. Knowing that he had built upon the solid rock of fact, he went about his work with unruffled calmness, little heeding the storm which might rage outside.

The publication of the "Origin" seemed to act as a stimulant to greater literary activity, for it was

followed in due course by the "Fertilisation of Orchids," the "Movements of Climbing Plants," "Variation under Domestication," the "Descent of Man," "Insectivorous Plants," the "Expression of the Emotions," "Cross and Self Fertilisation in the Vegetable Kingdom," the "Different Forms of Flowers," the "Power of Movement in Plants," and the "Formation of Vegetable Mould through the Action of Worms," besides new editions of some of them and of the "Origin," with sundry miscellaneous papers. This period is dealt with in the second volume of the present work, and the editors have grouped the letters (which in some cases go back to much earlier dates) under three principal heads: Man, Geology and Botany, with a short concluding chapter containing some on the Vivisection Controversy and miscellaneous subjects. In that controversy—needless to say—Darwin showed no favour to the noisy fanatics who set more store by a dog than by a man, though, as he writes to Lord Playfair, he strongly objected to "useless vivisection," namely, that undertaken for lecture-room experiments and without employing anæsthetics. That opinion had been also expressed fully in the "Life and Letters," but in view of "anti-vivisection tactics" the editors have been prudent in not omitting some reference to it in the present work.

The letters on geological subjects are very interesting, for with this science, though diverted from it in later life by pressure of other work, he never lost touch. As the volume of "Geological Observations" is still constantly in the student's hands, we need not enlarge upon its value, but the present work preserves for us numerous letters to Lyell and others on earth-movements, ice action, and the connection of cleavage with foliation, subjects in which Darwin's views may still be read with profit. In the first group he maintains that, as a rule, movements of elevation and depression generally affect large areas of the earth's crust, an opinion which has of late been gaining ground. Those on ice form a commentary on the views of its action, which were in process of change during his lifetime. Some of them relate to the noted Parallel Roads of Glenroy, on which he once wrote. He had then regarded them as old sea beaches, but abandoned this opinion in favour of the lake-side and ice-dam hypothesis. It would have been interesting to have seen how he would have dealt with the serious difficulty of the absence of glaciers from Glenroy, though an enormous dam is called into existence in neighbouring valleys. Perhaps this would have made him doubtful whether second thoughts are always best. As to cleavage and foliation, Darwin maintains that they have, as a rule, the same origin, instead of the latter being a result of stratification. That view is now accepted in a large number of cases, and his remarks on the connection of foliation with fluxion in igneous rocks show how acutely he observed and reasoned.

We are tempted to linger over these and the important group of letters on botanical subjects, but must hasten to a conclusion. It only remains to thank the editors for the way in which they have executed their task, and for these interesting volumes. They are most valuable, not only as a contribution to the history of science, but also as placing in clearer light the man himself. They were written *currente calamo*, as he rested in his armchair during the earlier afternoon, by way of relaxation from his more serious labours, so such slips of the pen as are indicative of fatigue or weakened health were not uncommon, yet they are often admirably expressed, and always attractive in their simplicity. Full of suggestive remarks, many of which will not readily become obsolete, they bring into clear relief Darwin's marvellous steadfastness of purpose, unflagging industry and patient endurance of the burden of chronic ill-health. This alone would have rendered many a man fretful or despondent; the letters, no less than the testimony of his family, prove that Charles Darwin had learnt the hardest of all lessons, "to suffer without complaining." We find in them repeated evidence of his freedom from acrimony or resentment, of his sympathy with other workers, and of that grand combination of a genuine humility with an almost unconscious intellectual strength, which impressed itself so deeply on all younger men. The life and the letters of Darwin have an ethical as well as a scientific value, for he was one of those who wore "the white flower of a blameless life," and could have faced without shrinking "that fierce light which beats upon a throne."

T. G. Bonney.

CAN THESE BONES LIVE?

Grundrisz der Mineralogie und Geologie, zum Gebrauch beim Unterricht an höheren Lehranstalten sowie zum Selbstunterricht. By Prof. Dr. Bernhard Schwalbe. Edited by Prof. Dr. H. Böttger. Pp. xviii + viii + 766. (Braunschweig: Vieweg und Sohn, 1903.) Price 13.50 marks.

It was in the forest-country south of Greifswald, where the wind sweeps down the highway from the grey-green Baltic, and crashes the pine-stems one against another, and blots out the shafts of a cold sunlight in sudden sheets of rain—it was here that we took shelter in a little wayside inn, and meditated on the vast uniformity of the Pomeranian plain. And here our host was a quiet old gentleman, a Vorsteher of something that demanded the imperial regard, the headman of a hamlet of five houses, and of finer education than the average burgess of an English country town.

He found out where we came from, and read to us from the English Bible, commenting on its archaic style. He then turned to Shakespeare, and finally left us with a copy of Carlyle's "Frederick the Great." When asked where he acquired this learning, he replied, "In the gymnasium at Greifswald."

And the work the full title of which stands above is also a product of gymnasia. In the hands of an inspired teacher, pupils might even become fond of it; but we are lost in admiration, tempered with sorrow, for those who would enter on it with a view to "Selbstunterricht." Our host in the Pomeranian flatland was probably capable of such greatness. House after house, moreover, throughout Germany boasts a "Con-

versationslexicon," in many volumes, as the principal ornament of its parlour, and here Schoedler's "Book of Nature" might also find a home. Dr. Schwalbe's volume, now before us, forms a part of the twenty-third edition of Schoedler's stately work, a "circle of the sciences" that still continues to revolve. The first part of the "Buch der Natur" has, it appears, already dealt with the life of plants and animals, and the palæontological history given by Dr. Schwalbe (pp. 193-230) is consequently only a slight sketch. The tremendous changes that have taken place from epoch to epoch in the predominant life-forms on the globe appeal to most minds that seek self-instruction in geology; to such the present treatise must appear phenomenally dry. Dr. Ernst Schwalbe, however, a son of the author, interpolates thirteen pages styled "Einige Worte vom Darwinismus," which lead to most just conclusions, but which are far more zoological than geological. The author's decease during the progress of the book has thrown much labour on the editor, Dr. Böttger, who has been asked to piece together detached portions of manuscript, and to supply important passages himself. He has certainly kept the work very fairly up to date, as in the description of the human remains in the Krapina valley, in Croatia (p. 592), and the expanded section on crystallographic symmetry (pp. 603-646); but such additions are often far removed from the matter on which they bear in the main text. The book opens, in fact, with a severe and very chilling account of crystal-forms, in which Naumann's symbols are prevalent, and in which the positions adopted for some of the drawings leave much to be desired. The optical characters, which are so much relied on nowadays, are dismissed in two pages, and the distinction between uniaxial and biaxial crystals is given with time-honoured incompleteness. The blowpipe-examination of minerals, so fascinating to schoolboys and to those working by themselves, is not dealt with from a practical point of view; and the description of minerals would give the beginner little conception of the connection of these bodies with the earth on which we live. The beauty of the objects is occasionally dwelt on; but their common mode of occurrence, and their geological relations, are left to a general chapter on mineral deposits, which follows the detailed catalogue of species. The account given of the felspars and other rock-forming minerals has very little value for the geologist, and bears signs of considerable antiquity.

The petrography is similarly in need of vitalising touches. The group of "lavas," as distinct from basalts and trachytes, is retained; and the inner meaning of rock-structures is not discussed. After a palæontological and stratigraphical episode, we return to petrography, on p. 216, with the almost extinct division of igneous rocks according to geological age. Then we swing back to palæontology, and to a table "nach Gümbel," which naturally takes no account of the recently disclosed richness of the Cambrian fauna of America. And so on, classically enough, until we ask why, with so many good German text-books in existence, gymnasia are to be treated to these special products of desiccation. May not the pupil exclaim, "And it was full of bones; and he caused me to pass by them round about; and lo, they were very dry"?

The sections on denudation and aggregation are, however, much more cheering, and the photographic illustrations are mostly new and excellent. From them the student may gain a real feeling for the varied aspects of the earth. The three plates showing the changes in the Karlseisfeld, in the Austrian Alps, at intervals of about ten years, are beautiful and impressive. But we are soon after (p. 603) drawn on into a series of "gemischte Waaren" in the form of separate articles, confirming or expanding what has gone before. Thus, "Crystallographic systems," 45 pages; "Nomenclature," 35 pages, in which the derivation of mineral names is given, with original Greek words and their transliterations into Latin letters; "On Caves," 22 pages; "Orogeny," 35 pages, with many modern features and admirable illustrations. Dr. Böttger has clearly had a difficult task in pouring new wine into old bottles. We gather (p. 744) that geology has no distinct place in the curriculum of the Prussian high schools, although mineralogy and petrography are admitted; and the late Dr. Schwalbe worked hard to introduce geological illustrations into the experimental work of other subjects. In the twenty-fourth edition of the "Buch der Natur," Dr. Böttger may have the opportunity of recasting this volume, and of abolishing the system of appendices; but for school work something more practical is required. It is to be feared that the Prussian scheme of education does not favour individual experiment; but the pupil cannot understand geology unless he has scratched his minerals with a knife, and gathered his fossils on the bare hillside. The Pomeranian plain is not ideal for such a purpose; but, even there, every field contains its treasures, and the glorious ice-borne blocks from Scandinavia give colour to each village street. The history of one of these, from pre-Cambrian to gymnasial days, is worth a thousand pages of conscientious compilation.

Grenville A. J. Cole.

CURIOSA MATHEMATICA.

Opinions et Curiosités touchant la Mathématique. Deuxième Série. By Georges Maupin. Pp. 332. (Paris: C. Naud, 1902.) Price 5 francs.

THIS is a very entertaining miscellany in which every reader will find something to his taste. Thus we have extracts from the works of sixteenth century mathematicians, still influenced by the methods of scholasticism; part of the debate in the Chamber of Deputies (August, 1835) on the French jury system, when Arago appealed without effect to the mathematical theory of probabilities; two specimens of circle-squaring (1852, 1855); and so on. Two or three extracts will serve to show how amusing some of these chapters are.

John Wilkins, after criticising adversely the cabalistic methods of the Jews, argues in true scholastic

fashion against the existence of more than six principal planets :—

"Or si quelqu'un demande, pourquoy il n'y a que six orbes des Planettes, Keppler respond :—Parce qu'il ne faut pas qu'il y ait plus de cinq proportions, tout autant qu'il y a de corps réguliers és Mathematiques, dont les costez et les angles sont esgaux les vns aux autres.—Or six termes accomplissent le nombre de ces proportions; et par conséquent il n'y peut auoir que six principales Planettes."

Could anything be more convincing? Perhaps, after all, Uranus and Neptune are mere *simulacra,* will-o'-the-wisps contrived by Satan to deceive a reprobate race of astronomers no longer faithful to the great principles of analogy.

We have the authority of the Reverend François Chevillard (1667) for believing that mathematicians are (or should be) born under the sign of the Twins. He says :—

"*Les Iumeaux.*—Ce signe rend son homme beau, misericordieux, sage, ingenu, libre, vn peu menteur, coureur et voyageur, mediocre en commoditez, assez fidelle pour estre Intendant des Finances, propre aux Mathematiques, aux Loix, et à l'Arithmetique, sçachant dissimuler sa cholere, mais il sera pour courir danger vers l'âge de trente-deux ans ou du feu, ou du fer, ou de la morsure de quelque chien. . . ."

Here is something more properly mathematical. John Abraham (1607) gives the product $6757 \times 346 = 2337922$, and after explaining the test by "casting out the nines," proceeds as follows :—

"Et d'autant que la preuue de 9 n'est si certaine que le contraire ou la preuue de 7 (*sic*). Nous auons fait la preuue par 7. Et pour ce faire faut chasser les 7 dizaines de la somme à multiplier, sçauoir de 67 restent 4 de 45 restent 3 et de 37 restent 2 qu'il faut poser à l'un des bras de la croix" (that is, the cross used in the old-fashioned way of casting out the nines: but Abraham's cross is like a big +), "puis en la forme susdite faut aussi chasser les 7 du multiplieur, sçauoir de 34 restent 6 et de 66 restent 3 qu'il faut poser à l'autre bras de la croix, et multiplier les deux figures l'vne par l'autre, sçauoir 2 fois 3 sont 6 qu'il faut poser sur le haut de la croix et pour la fin de la preuue faut chasser les 7 des 2337922 de 23 restent 2 de 23 restent encores 2 de 27 restent 6 de 69 restent 6 de 62 restent 6 et encores des 62 restent encores 6 qu'il faut poser au bras de la croix."

It will be observed that this amounts to finding the least positive residues of the factors with respect to the modulus 7, and comparing their product with the residue of the product of the given numbers. The residues are found by actual division, not by any special rule; curiously enough, it does not appear how the author found the 9-residues for the other test. No proofs are given to justify the process in either case.

The second part of Mr. Maupin's book (p. 160 to end) deals mainly with the notes of Albert Girard to the mathematical works of Stevinus. Both these men were very competent mathematicians, and a study of their work is very instructive. In their day, the science of mathematics was but little advanced beyond the stage at which it had been left by Pappus, Diophantus, and Ptolemy; the notation of analysis was still very imperfect; the methods of analytical geometry and infinitesimal calculus, as we now know them, had not been invented; the prevailing style of demonstration, as it appears to a modern reader, was both involved and diffuse. But the times were ripening for the great discoveries of Newton, Descartes, and Leibniz; and if, as compared with the achievements of their immediate successors, the work of men like Stevinus seems poor and insignificant, we must remember that the work of these humble pioneers was probably more important than appears at first sight. No one who has studied the history of mathematics can have failed to see how advance in the subject has accompanied improvement in notation. Now the essential features of modern notation are due to the mathematicians of the earlier part of the seventeenth century; and their service in devising it is really considerable. Besides this, they were the teachers of the younger mathematicians of their time; and we may not unfairly credit them with having done nothing to spoil and something to stimulate the minds of men with greater genius than their own.

The ingenuity of some of these old worthies, especially in diophantine analysis, is really remarkable, and it is not always easy to see precisely their method of procedure; for, after the manner of their time, they publish results without demonstrations. Some very curious results obtained by Girard (pp. 203-9 of Mr. Maupin's book) seem to show that he was acquainted with the reduction of a quadratic surd to a periodic continued fraction; thus he obtains 1039681/328776 as an approximate value for $\sqrt{10}$, and this rational fraction is, in fact, the eighth convergent to the infinite continued fraction which represents $\sqrt{10}$.

G. B. M.

ASTRONOMY FOR EXPLORERS.

Grundzüge der astronomisch-geographischen Ortsbestimmung auf Forschungsreisen. By Prof. Dr. Paul Güssfeldt. Pp. xix + 368. (Braunschweig: Vieweg und Sohn, 1903.)

As the field of the geographical explorer daily narrows, so do the number and excellence of books dealing with geographical exploration continually increase. The book under review treats of the determination of time, latitude and azimuth with a transit theodolite, and the methods described are the simplest in use by the explorer; it will serve, however, as an introduction to field astronomical methods generally.

The author leaves nothing unexplained, and commences with elementary definitions of number and quantity. A quarter of the book deals entirely with elementary arithmetic, algebra, trigonometry and analytical geometry. This is, perhaps, an excess of thoroughness; for the explorer in most cases wants to get to business as soon as possible, and if he has not previously obtained a knowledge of the elements of these matters, he is more than likely to be content to use accepted formulæ without investigation, so that it is not quite clear for what class of reader the book is written.

It appears from the publishers' preface that Dr. Güssfeldt has had considerable experience of field

astronomical methods, having spent some ten years exploring in tropical Africa, Egyptian deserts and in the Andes of Chile and Argentina. The methods described are sound and practical, and taking the book as a whole, it will undoubtedly serve well as a course of astronomical study for those explorers who can afford time to read it.

But the day of the explorer is nearly over, and it is very desirable to substitute topographical for exploratory methods wherever possible. This is actually being done at the present moment on the Gold Coast, where Major Watherston is making a topographical survey by means of long rigorous traverses controlled by azimuths. In difficult countries where rapid triangulation is impossible, this system should always be adopted. As regards the perennial difficulty of the initial longitude, it is not always realised that we have now a series of well determined longitudes throughout the whole length of Africa, that there has been a great increase in the number of telegraph lines in that continent, and that wireless telegraphy promises to be of vast assistance in the determination of longitude differences of quasi-geodetic accuracy.

As this book is no doubt primarily intended for German students, it is worth while noting that the German colonial empire throughout the world has an area of about one million square miles, and that the largest single block of German territory is German East Africa, with an area of less than 400,000 square miles. It is in the long run cheaper to survey such a country by topographical rather than by rough astronomical methods, and the results are far more trustworthy, topographical work including the determination at wide intervals of zenith telescope latitudes and telegraphic differences of longitude. It is believed that the German authorities are fully alive to the importance of these considerations, as may be inferred from the excellent work of Captain Hermann and Dr. Kohlschütter in East Africa, and from the recent boundary surveys in Togoland.

The importance of purely astronomical exploration diminishes yearly, and though it will be some time before the astronomical explorer becomes extinct, the scope of his usefulness grows continually less; his last home will perhaps be in Central Asia, in Brazil, or at the Poles. Meanwhile, he will find Dr. Güssfeldt's an excellent text-book in which to study elementary field astronomical methods, but he should only employ these when topographical methods are impossible.

C. F. Close.

OUR BOOK SHELF.

The Tutorial Physics. Vol. ii. *Higher Text-book of Heat.* By R. Wallace Stewart, D.Sc. Pp. viii + 396. (London: W. B. Clive, 1903.) Price 6*s.* 6*d.*

This is a new and considerably enlarged edition of a book which we have previously noticed (December 21, 1893). We then declared our belief in the writer as one capable of stating with all clearness and necessary accuracy the various laws, and of showing their practical application by means of appropriate examples. In its present form, he appeals to a more advanced class of student than hitherto; and the question arises whether the accuracy which was sufficient in an elementary statement is adequate in a more advanced exposition. With regard to the main part of the volume, we answer in the affirmative. The author has evidently been at great pains to secure lucidity and simplicity without a sacrifice of precision; and we cordially recommend the book to those who are willing to use it rightly. By this last phrase we mean to imply that it should be read to the accompaniment of prolonged work in the laboratory under the personal guidance of an efficient teacher. Granted this accompaniment, we think the book will be very helpful to those who are not taking physics as a principal subject of study, and who therefore do not wish to be confused by the bewildering detail and complication which larger treatises supply.

In a few places the above commendation must be qualified. On p. 244, Dulong and Petit are stated to have "found that for a given excess of temperature the rate of cooling depended not only on the temperature of the body, but also on that of the enclosure." That stumbling-block of expounders, the Joule-Thomson experiment, trips up the author repeatedly; though we readily admit that he goes straight on the whole. For example, on p. 272 it is declared to involve no performance of external work; on p. 281 the amount of external work done is expressed in the equation; on p. 282 the work is once more declared to be altogether *internal.* The first word on p. 283 should be *increase*, not *decrease.*

Vergleichende Anatomie der Wirbelthiere. Fünfte, vielfach umgearbeitete und stark vermehrte Auflage des "Grundriss" der Vergl.-Anatomie der Wirbelthiere. Von Dr. Robert Wiedersheim. Pp. xix + 686. (Jena: Gustav Fischer, 1902.) Price 16 marks.

Although in the title of the present work the word "Grundriss" is subordinated, the book is the fifth edition of that originally so named. Its second edition of 1888 replaced the author's Lehrbuch (1882 and 1886), and its third, of 1893, which formed the basis of the second edition of an English translation, was practically a new book. In this, certain modifications were first introduced which have characterised all subsequent editions, including the present one, in which the method of treatment remains unchanged.

The most marked advance in the book under review is the addition to eight of the nine sections of a series of short *résumés*, which materially enhance the value of the work, in the past a book of reference only.

In his preface the author enumerates fifteen subjects which have been especially modified and extended, chief among them the morphology of the head-skeleton, as lately determined by Gaupp. There are many minor curtailments and rearrangements in various parts of the book, and the recognition of the work of Milani and Häcker on the reptilian lung and avian larynx, of Paulli on the nasal labyrinth, of Budgett on the external gills of Gymnotus, of Oppel on the alimentary viscera, of Strong on the metamorphosis of the cranial nerves, and Bles on the nori abdominales, is sufficient to show that anatomists of all nationalities have been duly recognised, and that the book is up to date.

There are in all 711 text-figures, grouped to form 379 sets, and there is still the single coloured plate, designed to render clear the changes undergone by the cranial nerves in the passage from the aquatic to the terrestrial state. The bibliography, so largely the secret of the popularity of past editions, now reaches the appalling limit of 120 pp. In using this record

rightly, the student will soon realise that the bare titles but point the way to endless records of facts and considerations of importance not mentioned in the text, which it is the duty of the writer of a standard text-book to indicate. There are omissions in the list, but as matters go in comparative anatomy, the wonder is that it is so complete.

The book fully maintains the reputation of its predecessors, and we wish it success.

Nature and the Camera. By A. Radclyffe Dugmore. The Dainty Nature Series. Pp. xiii + 126. (London: Wm. Heinemann, 1903.)

The author of this delightful book gives us an ideal essay on "Nature Study," for he carries the reader away into country lanes and woods, far from the regions of smoke and habitations, and shows us samples of bird, animal, insect, reptile, and plant and tree life, which is now so admirably portrayed by the photographic lens. Undoubtedly the best study of Nature is Nature, and it may be added that the best way of recording it is by the utilisation of the photographic lens and sensitive plate, which are capable of giving us accurate and faithful pictures of occurrences which otherwise would be out of the reach of many of us.

In these pages, the author, who has made a speciality of this subject for many years, gives us an account of how to accomplish successfully the art of photographing things living under their natural conditions. Technicalities are reduced to a minimum, and the story is clear, straightforward, and to the point. Naturally, many difficulties are met with in attempting to photograph these various subjects, and the author describes each in turn, and shows how he has been able to overcome them. From a collection of nearly three thousand negatives taken by the author himself, he has been able to utilise some excellent examples for all the objects to which reference in these pages has been made, and these, 53 in number, have been here beautifully reproduced. Besides being a useful book for those who wish to photograph along these lines, it should be read with interest by those who enjoy hearing about the habits and peculiarities of the birds and other small creatures mentioned.

The Twentieth Century Atlas of Popular Astronomy. By Thomas Heath, B.A. Pp. 121; with frontispiece and 21 plates. (Edinburgh: W. and A. K. Johnston, 1903.) Price 7s. 6d.

In addition to the atlas this volume contains a very useful account of the elements of astronomical science, mathematical and spectroscopic, as it appears at the beginning of the twentieth century.

As the title indicates, the account is primarily intended for amateurs, and it will be found sufficient to give the beginner a fair working idea of the astronomy of the present day.

The fourteen chapters deal with time, celestial distances and apparent movements, solar physics, the moon and planets, eclipses, comets, meteors, &c., and the text is plentifully illustrated with diagrams, star charts and photographic reproductions of various objects.

Plates i.-xiv., inclusive, illustrate the appearances and apparent movements of the various members of the solar system, eclipses, comets, star clusters, nebulæ, spectra, the appearance of the corona at different eclipses, &c.; xv.-xx., inclusive, are star maps containing stars down to the fifth magnitude, nebulæ, &c., and xxi. shows the apparent yearly paths of various planets. All the plates are printed in white, or colours, on a blue ground.

The whole volume has been carefully compiled and well printed, and, with one or two exceptions of minor importance, appears to be free from typographical errors.

W. E. R.

Official Report of the Nature Study Exhibition and Conferences, August, 1902. Pp. 303. (London: Blackie and Son, Ltd., 1903.) Price 2s. 6d. net.

The Nature-study Exhibition held last year served the purpose of bringing together the work due to the efforts of independent individuals or institutions, and thereby enabled teachers to get a correct estimate of their results and obtain suggestions for future developments. The official report directs attention to the more successful results both in the list of awards and also in a too brief reference to work of special excellence. The report of the executive committee embodies extracts from the information supplied by principals with regard to their aims and ideals, from which useful hints may be gathered. It would have been convenient if this information had been arranged under subjects of study, or according to the phase of the subject. The addresses presented at the conferences occupy the greater part of the book. The paper offered by Prof. Lloyd Morgan is eminently practical and broad in scope. Prof. J. A. Thomson confined himself to advocating the seasonal method of nature-study, which offers a definite scheme of work. Herein lies an important point, which has not been sufficiently emphasised, that observation of objects taken at random does not train the mind, and that with correct observation should be combined a systematic course of study.

Friedrich Schleiermacher's Monologen—Kritische Ausgabe—Mit Einleitung, Bibliographie und Index. By Friedrich Michael Schiele. Pp. xlvi + 130. (Leipzig: Dürr'sche Buchhandlung, 1902.) Price 1.40 marks

Si sic omnia dixisset, the name of Schleiermacher would not have been so important as it is, for the thought of the "Monologen" is generally too impalpable and elusive, and the reader is often little helped or stimulated as the changes are rung on Freedom and Necessity, Time and Eternity, Outer and Inner. Besides, the style is often unnatural: poetic prose and too consciously so. Still, the book throws an interesting sidelight on Schleiermacher and his age—when "to be young was very heaven," for the last monologue is a hymn to youth. This edition is most purposeful; its basis is the 1800 text with the original spelling, the variations of the 1810 and 1822 editions being given at the foot of each page. The introduction is sensible, and the bibliography ranges over the whole field of Schleiermacher's ethical philosophy. In the elaborate index the winnowed grain of the "Monologen" is neatly stored.

R. G. N.

The Mycology of the Mouth. By Kenneth W. Goadby, D.P.H., L.R.C.P., M.R.C.S., L.D.S. Pp. xv + 241. (London: Longmans, Green and Co., 1903.) Price 8s. 6d. net.

A text-book of mycology suited to the needs of the dental profession has long been a desideratum, and Mr. Goadby has succeeded in the task of writing one. The first half of the book is devoted to general principles and methods, the remainder to the special bacteriology and mycology of the mouth and its diseases, such subjects as dental caries and pyorrhœa alveolaris being treated at length. We have noted but few mistakes, e.g. Wedl for Widal (p. 41), Buchner's *tube* for Buchner method. In hanging drop preparations, the usual and convenient hollow ground slides are not mentioned, the antitoxin unit is not quite accurately defined, and the dose of diphtheria antitoxin recommended is too small. The book is well and profusely illustrated.

R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Quadrantids, 1903—A Coincidence.

A FRIEND of an astronomical turn of mind called a few evenings ago and related to me the following :—

"At 5 p.m. on the first Saturday in January, *i.e.* January 3, I was on a hill outside Bangor, Co. Down, looking westwards, when a large bright meteor, magnitude = Jupiter, appeared above the south-western horizon, and rose slowly and perpendicularly until it attained an altitude of about 30 degrees : duration, two or three seconds : no sound or explosion, but a fine sight in the strong moon or twilight."

Observers will notice the agreement of the date of this meteor with that of the Quadrantids, and one is tempted to ask if it could be a member of that system, drawn out of its course, or was it an ordinary slow, direct-motion, fireball from the west? My informant says, judging from the position of Jupiter and the moon at the time, that its path lay in the ecliptic.

I may remark in connection with this subject that on or about the date of maximum of some of the larger showers, I have frequently noticed, and sometimes had reported to me, the observances of slow, irregular meteors which, although obviously connected in some way with the shower under observation, were yet quite unconformable as to the radiant ; and I came to the conclusion that they were meteors which had been trapped or captured at former returns, and were then members of those sun-earth systems referred to by M. Schulhof in his papers "Sur les Étoiles Filantes" (*Bull. Astron.*, March–September, 1894, pp. 64, 65).

The question may not have hitherto received the attention it deserves, but I leave it to those more competent to judge. The outside planets control their cometary systems and swarms. Why not the earth on a smaller scale?

My own observations of the shower this year were not at all satisfactory, and were briefly as follows :—

January 2.—12–1 a.m., Quadrantids nil.
January 3.—Overcast.
January 4.—2.30–3 a.m., Quadrantids 15.

The display was evidently closing when I took up my watch. I, however, placed the hourly rate as high as sixty for the short time it lasted. Several of the meteors were fine, bright, steel-like flashes, straight from the radiant through the zenith, in marked contrast to others, which were of a much slower and sporadic-like character.

W. H. MILLIGAN.

26 Cooke Street, Belfast, March 23.

THE phenomenon referred to in his letter, by Mr. Milligan, that the principal star-showers of the year are in general accompanied simultaneously, or nearly so, by a somewhat more than ordinary abundance of shooting-stars from centres not very far distant from that of the principal display, has long been observed, and has indeed received an elaborate amount of attentive study, as a pretty clearly distinguishable character of several of those showers ; but it can hardly be said that observations of those dispersed contemporaneous meteor-flights have yet been made with such satisfactory exactness as either to assign them all to real centres, or to say with certainty how many of them are stragglers from the main and from the neighbouring shower-sources. In the present imperfection of our knowledge of the phenomenon's real features, no recourse, it may be feared, can yet be had with any prospect of successful issues to hypothetically ventured explanations of these, either closely grouped together, or else, by perturbative attractions, erratically scattered and deflected contemporaneous meteor-systems.

The Quadrantid shower appears to have reached its maximum this year in the evening and night of January 3 ; for in watches of about two hours towards midnight on that date, rather rapid hourly rates of appearance of the Quadrantids were noted both by Mr. T. H. Astbury, at Wallingford, and by Mr. A. King, at Leicester, some of the meteors recorded being very bright ones ;[1] and this date of its greatest brightness was thus confirmed by the considerable intensity of the shower observed at a later hour on the same night by Mr. Milligan in Belfast. Much clouded sky, and rain prevailed on that night at Slough, but in a clear interval of about 1 hour, between 12h. 35m. and 13h. 50m., nine meteors were mapped, of which four or five diverged from Quadrans. During a watch of nearly 5 hours on the preceding night of January 2–3, from 12h. 10m. to 17h. 5m., with continually clear sky,[2] thirty-four meteors were mapped and three or four more were seen, appearing at a steady rate of seven or eight per hour. Of the mapped meteors five were Quadrantids, three of them equal to or brighter than first magnitude stars ; all seen in the last $1\frac{1}{2}$ hours, and none in the first $3\frac{1}{2}$ hours of the watch, denoting apparently a distinct beginning of the shower at about 3h. 30m. a.m. on the morning of January 3.

The radiant-point of four Quadrantid tracks was well marked at $235°+54°$; but with five more on January 3, all from about $225°+49°$, the mean of the nine paths was at $229°+52°$. At 16h. 38m. on January 2, a Sirius-like brief white flash was quite stationary for half a second, at $228°+59°$. A mean place of the radiant-point at $228\frac{1}{2}°+52\frac{1}{2}°$ was also obtained by Mr. W. E. Besley, at Clapham, from six Quadrantid tracks among seventeen to twenty meteors mapped and glimpsed in a watch, with clear sky from 11h. to 13h. 20m., on the night of January 3. Evident signs of radiation by three or four meteors from each point were also noted here from $180°+55°$ (δ Ursæ Majorids, II.), $258°+44°$ (β Draconids), and $235°+36°$ θ Coronids), round the Caput-Böotid, or Quadrantid radiant-region, and notably also from one more distant source (ϵ Craterids), at about $160°-8°$ (five meteors), and from a weaker one at about $210°+6°$, Mons-Mænalids or (15) Böotids.

The large meteor described by Mr. Milligan as having been seen at Bangor, Co. Down, at 5h. p.m. on January 3, shooting upwards in the S.W. nearly along the path of the ecliptic, or from some radiant-point near β Aquarii in the sunset vicinity, was indeed, as early evening fireballs sometimes are, directed from an exceptionally far western quarter. But as its radiant-source was at least 100° off from that of the Quadrantids, then near the N.W. horizon, it could only, surely, be in a course of countless ages that we might suppose it to have become so widely divergent in its route from the star-shower's path-direction, since this would need many times repeated, always like-acting close approaches to the earth, with the only small deflecting actions in each of them which the earth by its attraction would be able to exert on the direction of its motion.

A. S. HERSCHEL.

Observatory House, Slough, March 28.

Analogue to the Action of Radium.

Is not the generation of radiant energy by radium analogous to the humming of telegraph wires and poles? In each case the emission of energy is a response to surrounding disturbances which elicit no response from bodies in general. The disturbances from which the energy is drawn are irregular movements, of the air in the one case, and of

[1] From Mr. King's description in the *English Mechanic* of February 6, 1903 (vol. lxxvi. p. 544), of his view of 8 to 10 Quadrantids seen and mapped in 45m. of cloudless, only slightly hazy sky, after 9h. (none having appeared in the previous hour, from 8h. to 9h., of equally clear watch), their rate of appearance then, allowing for haze, and for time spent in registration, was about 17 to 23 per hour, and they were "coming as frequently as the Perseids in the early hours of their maximum dates." The eight mapped flights (of which one was as bright as Sirius, and five were equal to or brighter than second magnitude stars) showed a radiant-point at $228°+52°$. Mr. Astbury saw 19 Quadrantids during a watch of 1h. 45m. between 6h. and 10h. 30m. The thirteen mapped paths gave "two good centres, one at $231°+54°$ (5 Quadrantids) and a second at $225°+53°$ (5 Quadrantids)." The three remaining "fell near, but not *on*, these centres."

[2] Three or four flashes of lightning were noticed on that night, as also happened on that date in the bright return of the Quadrantid shower in 1900. In the clear watch of $5\frac{1}{2}$ hours kept at Slough on the latter night, considerably more meteors (35 together) than the 28 observed well centred paths from Quadrans, appeared to diverge from the following five positions, which, with the δ Ursid centre seen this year, were distributed round the January shower's radiant region near the Huntsman's head pretty closely, and pretty evenly in all directions, thus :—$216°+34$ (ρ Böotids, 8 meteors), $243+29°$ (ξ Coronids, 8 meteors), $257°+44°$ (β Draconids, 7 meteors), $260°+65°$ (ζ Draconids, 7 meteors), and $242°+75°$ (γ Ursæ Minorids, 5 meteors).

the ether in the other. The responsive power is due to structure, which in the one case is on the large, and in the other on the molecular scale.

J. D. EVERETT.

11 Leopold Road, Ealing, W., March 31.

FIG. 1.—Triangulation at Spitsbergen, for the measurement of an Arc of Meridian.

MEASUREMENT OF AN ARC OF MERIDIAN IN SPITSBERGEN.

THE *Revue générale des Sciences* for December 15 and 30, 1902, publishes an account of the measurement of a meridian-arc in Spitsbergen from the pen of M. A. Hansky. Other accounts of the same enterprise have appeared in various journals, and some of them are before me.[1] The history of the undertaking is as follows:—In the year 1823 Sir Edward Sabine was sent to Spitsbergen and Greenland to make "experiments to determine the figure of the earth by means of the pen-

[1] Carlheim Gyllensköld in *Ymer*, 1900, h. 2; O. Backlund in *La Géographie*, April 15, 1901, p. 287, and later numbers; Rapport till Kongl. Kommitten för gradmatning pa Spetsbergen (Stockholm, 1900, &c.).

dulum vibrating seconds in different latitudes." Sabine's experiences in Spitsbergen led him to conclude that that country, and that alone in the Arctic regions, owing to its exceptionally mild climate for so high a latitude, was suited for the actual measurement of a meridian-arc of any valuable length. Accordingly he wrote a memorandum advocating the undertaking, which will be found in the *Quarterly Journal of Science and the Arts* for 1826 (pp. 101-8). Nothing was done in the matter, but the proposition was not lost sight of. When the Swedes, in and after 1858, made their remarkable series of scientific expeditions to Spitsbergen, they set before themselves as one of their objects a preliminary survey and the choice of stations for an arc-measurement, and as long as Sabine lived they kept him informed of their interest in his proposal.[1] The The observations are now being reduced, and the result will probably be published in 1904.

The southern extremity of the arc is Mount Keilhau, near the South Cape; the northern is Little Table Island (Fig. 1). The difference in latitude between the two is 4° 10′. The Russians undertook the southern and easier part of the arc, from Mount Keilhau to Thumb Point, at the south end of the Hinloopen Strait. The Swedes took the northern part. Both nations established winter stations—the Russians in Horn Sound, on the site of the old whaling station of the London Muscovy Company; the Swedes in Treurenberg Bay, close to the harbour, where Parry's station was established in 1827. Horn Sound is always easily accessible. Treurenberg Bay is not accessible at all in many seasons. The Swedes had bad luck in this respect, and the best part

FIG. 2.—Whales Point, where the Russian base was measured.

detailed proposal, with a map of the net, was published by Dunér and Nordenskiöld in a paper presented to the Swedish Academy on September 27, 1866.[2]

It was hoped for a long time that England would join Sweden in carrying out this work, but nothing was ever done, and the years passed. At length, all hope of English cooperation being abandoned, the Swedes turned to Russia, and, in or about 1897, an agreement was come to by the two Governments for a series of joint expeditions to perform the measurement. The work was actually begun in 1898, and concluded in 1902.

of two seasons had to be wasted in painful efforts to reach their base station.

The year 1898 was devoted to a preliminary expedition by the Swedes. The Russians began work in 1899, and spent the following winter at Horn Sound. They likewise devoted the summer seasons of 1900 and 1901 to their share of the work. The Swedes were not able to finish in 1901, so they returned for one more long and arduous season in 1902, by which the whole undertaking was finally carried to a successful issue. M. A. Hansky's articles only describe the Russian expeditions. They are admirably illustrated by photographs, but, unfortunately, it is not always stated what is the exact subject of the view. Thus, Fig. 1 is entitled "Montagnes et Glacier au Spitzberg," a ridiculous title for any scientific journal to accept. I believe the view

[1] *Vide* Dr. Otto Torrell's letter to General Sabine, December 12, 1863, in *Proc.* Roy. Soc., xiii pp. 83, 84; and Capt. Skogman's letter to the same, November 21, 1864, announcing the completion of the preliminary survey, in *Proc.* Roy. Soc., xiii. pp. 551-553.

[2] K. S. Vet. Akad. Handl. Bd. 6, No. 8.

was taken in Fair Haven, the great bay at the north-west angle of the main island, but it may be in Magdalena Bay. Incidentally, I may also mention that the geographical nomenclature employed is very inaccurate, thus the name Mount Hedgehog, which belongs to Hornsundstind, is given to a hill on the east coast, and other names are likewise misapplied. Mr. Arnold Pike is called Mr. Pikes.

The Swedes measured their base at Treurenberg Bay, the Russians theirs near Whales Point (Fig. 2). For this purpose they used the Jäderine apparatus, in which a wire consisting of Guillaume metal (a steel and nickel alloy), about 25 metres long and 1·7 mm. thick, is supported at a fixed tension on a series of tripods, used in pairs successively. By this means the base was measured in four days, each measurement being repeated four times with two different wires. The limit of error is stated to be not more than 1 in 400,000.

At the beginning of the season of 1899 the Russians went up to Horn Sound, and began establishing their winter station close to a spot where Garwood and I spent a week in 1897, so that it was not, as they imagined, "a spot where for more than two centuries no human being has lived." Here, in fact, throughout the eighteenth and part of the nineteenth centuries the Russians themselves had a trappers' winter establishment. While the houses were building, the observers went for a trip to the north, but the weather was very bad. Then they went round to Wybe Jans Water (which they call Storfiord) to commence the observation of their ten triangles, one of which had a side 130 kilometres long. They found the sea free of ice—an unusual condition to the eastward—and were able to land anywhere with ease. They were astonished by the relatively rich vegetation on Anderson Island. Not until August 6 could they actually begin observations from the signal point at Cape Lee, where they spent twenty days and could only work on three. They had to abandon the place before their work was done. The wintering party settled in whilst the others returned home. The winterers next spring made overland expeditions to Mount Keilhau, and began work there. In June, 1900, the other observers returned from Europe. It was several weeks later before the Keilhau observations were complete. Meanwhile, others were exploring the interior of the ice-sheet from Klaas Billen Bay, to find a junction signal-point for the Swedes and Russians. They succeeded after forty-five days, and built a pyramid on Mount Tchernycheff, a point first discovered by me in 1897. At Whales Head the observations were very protracted, and ice cut the observers off, so that it was long before they could get away. An expedition went overland to relieve them from Low Sound (wrongly called Van Mijen Bay). This was about all that was accomplished that season.

In 1901 the weather was much more favourable. The Russian base was measured near Whales Point. The remaining stations were occupied as far as Thumb Point, and the work completed. A final visit was paid to the abandoned winter station, and the expedition returned home in safety and content.

MARTIN CONWAY.

SEISMOMETRY AND GÊITE.

OBSERVATIONS on earthquakes which have transmitted vibrations to all points upon the surface of our globe apparently lead to conclusions respecting the physical nature of its interior. The following notes indicate the character of these conclusions, and at the same time suggest directions in which these may be harmonised with astronomical and other requirements.

Within a radius of 10° or 20° of a centrum, the velocity of transmission of the larger earthquake waves varies between 1·8 and a little more than 3 km. per second, such variations being usually attributed to the nature of the medium through which the waves have passed. Beyond these limits, and up to 165°—that is, to near the antipodes of an origin—speeds which are practically constant prevail.

The large waves have a velocity which, if regarded as "arcual," is constant at about 3 km. per second, whilst the preliminary tremors, if it is assumed that they travel along paths approximating to chords, quickly attain a velocity exceeding 9 km. per second.

The constant velocity for the large waves and the high velocity for their precursors preclude the idea that either of them were transmitted through the heterogeneous quasi-elastic crust.

If the large waves are regarded as the outcroppings of mass waves, then as pointed out by Dr. C. G. Knott the law which would govern their transmission so that their apparent arcual velocity should be constant would be "most complicated and improbable." Considering this uniformity of speed in conjunction with observations which indicate that as they pass beneath country after country they give rise to tilting phenomena on the surface, and that the amounts of tilting recorded at different stations in areas like Great Britain are, at least for the smaller disturbances, practically equal, the conclusion arrived at is, that the large waves of earthquakes are transmitted through a comparatively homogeneous medium beneath the crust, which, as they pass, is forced to rise and fall like a raft upon an ocean swell.

If the preliminary tremors followed the same path as the large waves, then their velocity would not be constant, but would vary from 3 km. per second in the vicinity of their origin to 15 km. per second as they approached the antipodes. On the contrary, if it is assumed that the paths approximate to chords, then for chords of 10°, 20°, 30°, 40°, 50°, 60°, 80°, 90° and 150° the corresponding average velocities in kms. per second are from 3 to about 5, 7·3, 8·1, 8·5, 8·5, 8·8, 9·0, 9·3 and 9·3 these being minimum rather than maximum values.

The lower of these velocities, all of which are average values deduced from observations dating back to 1889, may be due to the fact that they refer to the shorter chords, a considerable portion of which lie within and near what is assumed to be the crust of the earth.

But even accepting as appears to be necessary an increase in average velocity along paths as they are taken nearer and nearer to the centre of the earth, the above figures show that this increase is not very great. The inference is that not only has the world a high rigidity, but also that its interior is probably fairly uniform so far as those properties are concerned which determine the rate at which it transmits vibrations. Possibly, therefore, it may have a density throughout its nucleus which is nearly uniform. Unless we assume that as we descend in the earth elasticity and density increase in about the same ratio, to which hypothesis there are objections, it seems likely that the nucleus of the earth has a density that is more nearly uniform than is generally assumed. Prof. Wiechert has shown that such a nucleus made of iron, density 8·2, and four-fifths of the earth's radius, covered by a shell of density 3·2, satisfies the astronomer. Such a world, however, does not comply with what appear to be the requirements of seismology. Iron or steel do not transmit vibrations at the observed rates, whilst chordal velocities within the assumed shell would closely approach those observed along chords which are largely within the core. If a homogeneous nucleus

not less than 19/20 of the earth's radius sufficiently dense and rigid to comply with astronomical tests can be defined, the same might also approximate to the conditions assumed not only by seismologists, but also by physicists. The shell covering such a nucleus would be about 200 miles in thickness. The physical characters of this shell would in all probability change rapidly from those of the crust of the world to those of its nucleus, corresponding to the observed rapid changes in chordal velocities. At a comparatively shallow depth, say 40 miles, high temperatures would result in fusion, and inasmuch as ice, iron, copper and other substances at or near their melting point float on their own solutions, fusion is a state that would partly be promoted by high pressure. At greater temperatures, whatever the pressure might be, fluids would become gaseous, and the gases would be dense, but slightly compressible and viscous. In certain respects, therefore, they would resemble a solid. This is the view of Arrhenius, who assumes a core of gaseous iron the dimension of which is that assumed by Wiechert.

One reason for selecting iron or gaseous iron in an equally dense state is that a nucleus of such material of the specified size will account for the weight of the world as a whole. What, however, is sought for is a body probably a mixture of the commoner elements in a state approaching that of closest crystalline atomic packing, which has a radius 19/20 that of the earth, a specific gravity less than that of iron, but greater than 5·5, which keeps fairly homogeneous, and can transmit compressional vibrations half as fast again as steel. This material may be called *gēite*, a term as much required as *magma* and *crust*, by which gēite is enveloped, and *gēoid*, which refers to the form these materials collectively exhibit.

Whether solid or gaseous, *gēite* may possibly find its chemical equivalent in certain meteorites, and therefore largely consists of iron alloyed with a small proportion of nickel and other elements. If we assume that the shell covering this mixture has a thickness 1/20 of the earth's radius, and an average density of 2·7—the density of the world being taken at 5·5—it follows that the density of the gēite core is 5·96, or approximately 6. The elastic modulus for a core of this density which conveys vibrations with a speed of at least 9·5 km. per second is 451×10^{10} C.G.S., or roughly speaking, a little more than twice the Young's modulus for Bessemer steel (207×10^{10} C.G.S.).

With improvements in seismometrical arrangements, it seems likely that speeds somewhat higher than those here given will be recorded. Within the core itself, a velocity of 9·5 km. per second must be exceeded. For the moment let this be increased to 10 km. per second whilst within the crust let the average speed be 3 km. per second. With such assumptions, if the covering shell is about 40 miles in thickness, the *calculated* times to traverse chords corresponding to axes of 20, 30, 40, 50, 60, 80, 90 and 150 degrees would be 6·1, 7·5, 8·7, 10·2, 11·6, 14·5, 15·7 and 21 minutes. The *observed* times for these paths are 5, 6·5, 8·5, 10·5, 12, 15, 16 and 22 minutes. These approximations between calculations and observations suggest that the region of rapid change between crust and gēite commences where melting temperatures probably prevail.

In venturing these speculations on a gēitic core which will satisfy seismometrical and other tests, the fact must not be overlooked that, as earthquake measurements are yet in an embryonic state, figures which have been given relating to the same, although they represent the work of many years, are subject to modification. Amongst the various earth cores which are in harmony with the requirements of astronomy and geodesy, there is at least one which is homogeneous. If the radius of this can be increased 1/7 and it can have the properties of gēite, it will also accord with seismometrical observations.

Other speculations respecting the arrangement and character of materials beneath the earth's crust are based upon the fact that at certain observatories magnetic needles are disturbed by the large waves of earthquakes. These perturbations do not appear to be explained by the assumption that the magnetometers have been tilted. An alternative is to assume that they are due to changes in magnetic intensity possibly brought about, as Capt. E. W. Creak, F.R.S., points out, by changes of stress in a near magnetic medium. If this is the case at those stations where needles are caused to rotate, magnetic intensity and gravity should have abnormal values. This appears to be true for Batavia, near to which there are many volcanoes, indicating the proximity of dense magnetic materials, and for Bombay, where there is basalt, and at no great distance a hidden chain of heavy matter revealed by gravitational observations. At Kew and Greenwich and other stations where needles are not disturbed, magnetic intensity and gravity are not abnormal. Generally speaking, where horizontal force is comparatively low, the difference between the value of *g* as observed and as expected is also low, and to a certain extent the contrary holds good. On these points, however, until more material has been collected, it is impossible to speak definitely.

What seismometrical observations then lead us to suspect is that beneath the light crust of the earth, which we know to be thinner in some places than in others, there is a magnetic medium of density greater than the crust, which, as we descend in depth, may rapidly pass into a fairly homogeneous nucleus of gēite, the dimensions, physical and chemical characters of which have been suggested.

J. Milne.

THE SOUTHERN CROSS ANTARCTIC EXPEDITION.

The magnetic observations made in this expedition[1] have been reduced and prepared for printing by Dr. Chree, F.R.S., and M. Bernacchi, and the meteorological by Commander Hepworth, C.B., and Mr. Curtis, of the Meteorological Office, under the direction of Dr. W. N. Shaw, F.R.S., secretary of the Meteorological Council, and the results have been published by the Royal Society. In this expedition, fitted out by Sir George Newnes, the magnetic observations were made in about equal proportions by M. Bernacchi and Lieut. Colbeck, R.N.R., other observers also giving their assistance in the meteorological work.

The magnetic observations consist of determinations of declination, horizontal force, and inclination, made at Cape Adare, in latitude 71° 18′ south, and longitude 170° 9′ east, with some detached observations of inclination at other places. At Cape Adare observations of declination were made on a number of days in the months of April, May, October, November and December, 1899, giving a mean easterly declination of 55° 49′. Corresponding observations for horizontal force give a mean value (C.G.S. units) of 0·04143, and observations for inclination a mean value of 86° 34′. Observations for the diurnal variation of declination were made on three days, in April and May, 1899, and January, 1900, respectively, giving on the whole a diurnal movement of some 2°, that on the April day

[1] Magnetic and Meteorological Observations made by the *Southern Cross* Antarctic Expedition, 1898–1900, under the direction of M. Borchgrevink, Commander of the Expedition.

being very much greater than that on the day in May—three times as great—indicating in a short time a seasonal change that seems to require further observation to confirm. The material is insufficient for much to be said as regards diurnal variation of horizontal force.

Dr. Chree adds the remark that though at first sight the changes in declination seem quite out of proportion to the changes of the force, this is not really the ease, but that, as a matter of fact, the changes in direction and intensity are occasioned by disturbing forces which are of the same order of magnitude. He makes some comparison also with results found in the *Erebus* and *Terror* voyage.

There are notes of aurora. On one occasion, May 30, 1899, it is remarked that the movement of the magnet was most conspicuous during the active time of the aurora. Dr. Chree adds that many of the observations were taken in disadvantageous circumstances, and with a limited instrumental outfit, so that some of the conclusions arrived at should be accepted with reserve, at the same time remarking that the zeal and care of the observers under physical discomfort seemed to merit this attempt to do full justice to their work which, it is thought, might help to direct attention to special points of inquiry as regards other expeditions setting out, or likely so to do.

The meteorological results include a daily record of barometric pressure, air temperature, depression of wet bulb, direction and force of wind, character and amount of cloud, bright sunshine and precipitation, from March, 1899, to January, 1900, the observations (excepting of the last two mentioned elements) being taken at intervals of two hours day and night in the months of June and July, and in the remaining months at intervals of two hours from 9h. a.m. to 9h. p.m., in all cases accompanied by descriptions of weather; there are also various monthly abstracts of meteorological phenomena. Interesting descriptions of the numerous appearances of aurora are given, but whether synchronising or not with unusual magnetic motion does not directly appear, excepting on the one occasion already mentioned. The meteorological section is preceded by an introduction by M. Bernacchi explanatory of various matters, at the end of which he says it is of course premature to attempt to give a truly satisfactory description of the prevailing winds and temperature conditions in high southern latitudes until one year's observations at numerous stations on Antarctic lands are obtained, but expresses the hope that the Cape Adare observations may yet make our knowledge of the region less hypothetical than before.

NOTES.

The death is announced, in his eightieth year, of Prof. Julius Victor Carus, professor of zoology in Leipzig.

The German Association of Naturalists and Physicians will hold its seventy-fifth annual meeting this year at Cassel, on September 20–26.

The annual meeting and conversazione of the Selborne Society will be held on Tuesday, May 5. The president, Lord Avebury, will occupy the chair.

An international agricultural conference will be opened at Rome on April 13. Sir Thomas Elliott, secretary to the Board of Agriculture, will represent the Board at the conference.

Lord Blythswood has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

The University of Toronto has, *Science* reports, received subscriptions amounting to 6000*l.* toward a convocation hall, of which sum Mr. Chester Macy has given 1000*l.*, and Prof. and Mrs. Goldwin Smith 400*l.*

The following are the subjects of lectures arranged for the Wednesday evening meetings of the Society of Arts after Easter:—"Modern Bee-Keeping," by Mr. W. F. Reid; "Automatic Wagon Couplings," by Mr. T. A. Brockelbank; "The Construction of Maps and Charts," by Mr. G. T. Morrison; and "Preservation of Big Game in Africa," by Mr. E. North Buxton.

The Carnegie Institution has granted 1200*l.* to be expended under the direction of Dr. T. C. Chamberlin, of the University of Chicago, in research relative to fundamental problems in geology. The Institution has also made a grant to Dr. J. E. Duerden, late curator of the Jamaica Museum, to assist him in his work on the morphology of recent and fossil corals.

The council of the Geologists' Association has arranged an excursion for April 18 to New Cross to examine the reopened cutting south of the L.B. and S.C.R. station, which shows the junction of the London Clay and the beds below. This interesting section will be hidden again shortly, and geologists who have not yet examined it will be glad to hear of the excursion, the details of which were arranged too late for insertion in the April circular of the Association.

Replying in the House of Commons to a question by Mr. Schwann asking what is the present position of Mr. Jamsetjee N. Tata's scheme for a scientific research institution in India, and what support has been given to the scheme by the Government of India, Lord George Hamilton, the Secretary of State for India, said that he understood that Mr. Tata's scheme for a scientific institution is in abeyance for a time.

A mineral survey of Ceylon has been commenced with Mr. A. K. Coomaraswamy as director, and Mr. J. Parsons as assistant. It is intended to carry on investigations for three years, the results afterwards to be embodied in a report on the mineral resources of the island. Chemical work in connection with the survey will be carried out at the Imperial Institute, South Kensington. The headquarters of the survey are for the present to be at Peradeniya.

A correspondent of the *Lancet* reports that Mr. Henry Phipps is so pleased with the purposes to which the Viceroy decided to devote his donation of 20,000*l.*, viz. between a central agricultural laboratory and a Pasteur institute for southern India, that he has increased his gift by another 10,000*l.* The Government of India hopes to be able to carry out measures for combining agricultural education, scientific research, and practical experiment in one locality.

The Paris correspondent of the *Times* announces that Dr. Roux, of the Pasteur Institute, has been awarded the Prix Osiris of 100,000 francs by the Institute of France. We learn from the same source that the prize owes its existence to the generosity of M. Osiris, and is now awarded for the first time. It has been founded as a stimulus to original discovery and valuable work in the domain of science, art and letters. In unanimously deciding to give the prize to Dr. Roux, the Institute of France has recognised the high value of his scientific labours in preventive medicine and bacteriology.

The Elliott prize for scientific research will be given this year, the *Pioneer Mail* announces, to the author of the best original essay composed during the year 1903 giving the results of original research or investigation by the essayist on chemistry. Any native of Bengal, including any Eurasian or domiciled European residing in Bengal, may compete for the prize. Essays of competitors must be sent in to the president of the Bengal Asiatic Society by the end of December, 1903. Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal.

The following earthquakes have been reported within the last week:—April 3.—Several earthquake tremors, two of them alarmingly violent, have occurred during the last three days, in the Andijan region. Similar shocks have been felt contemporaneously in the Southern Urals. April 4.—Violent shocks of earthquake are reported from various parts of the province of Catania. A shock of earthquake was felt at 2 a.m. at Mentone. Houses were shaken. There was no recurrence of the shock, which only lasted half a second.

A new turbine steamer was launched at Dumbarton from the yard of Messrs. Denny Bros., on April 4, for the Cross-Channel service of the South-Eastern and Chatham Railway. The new vessel is of the same type, though larger, as the vessels which have been successful on the Clyde. The machinery will consist of Parsons's turbines, three being fitted, with three lines of shafting. In manœuvring, the centre shaft runs free, and the two side shafts then take the place of ordinary twin screws. The builders have undertaken that this vessel shall have an average sea speed of 21 knots, and it is expected that the vessel will perform the voyage from Dover to Calais in forty-five to fifty minutes.

Reuter's Agency is informed that Dr. T. Rubin, of Upsala, the leader of the scientific expedition which has been dispatched to Africa by the British South Africa Company, has left England. He was accompanied by Dr. Stoehr, the medical officer. After conferring with Sir David Gill, the Astronomer Royal at Cape Town, Dr. Rubin and the other members of the expedition, who will join him in South Africa, will leave for Chinde *en route* for Fort Jameson. He will then confer with the Administrator of North-East Rhodesia, and at once proceed to the work of the geodetic survey.

The *Geographical Journal* announces further details of the programme of the International Geological Congress to be held in Vienna in August next. There will be discussions on overfolded or overthrust planes relating to the structure of the mountains of Scotland, the Jura, and the Alps. A special sitting will be devoted to questions concerning the geology of the Balkan Peninsula and the East. The surface geology of the town of Vienna will also be discussed. The extensive engineering works carried out in the neighbourhood during the last ten years have exposed many deposits which have led to important discoveries by Prof. Suess. A paper on the subject will be illustrated by a large geological map on a scale of 1 : 10,000, and numerous sections.

The Board of Trade has informed the secretary of the Engineering Standards Committee that the sum of 3000*l.* has been included in the Board of Trade vote, for 1903–4, as a contribution towards the funds of the Engineering Standards Committee for that year only, on the understanding that the Treasury is not thereby pledged to continue the grant in later years. The actual expenditure under the vote will have to be authorised by the Railway Department of the Board of Trade on the recommendation of a committee specially appointed for the purpose by the Institution of Civil Engineers. The committee appointed by the Institution includes:—the president and the senior vice-president of the Institution of Civil Engineers; Mr. James Mansergh, F.R.S., Sir John Wolfe Barry, K.C.B., Sir William Preece, K.C.B., Sir Benjamin Baker, K.C.B., and Sir Douglas Fox, past presidents of the Institution; Mr. Archibald Denny; with a representative of the Board of Trade.

The spring meeting of the Institution of Naval Architects was held in the rooms of the Society of Arts last week, when the annual report of the council was presented, and new officers were elected. The report states that a committee of the council has, during the past year, been considering the possibility of raising a fund for the construction of an experimental tank at Bushey, in connection with the National Physical Laboratory there, in accordance with the resolution passed at the summer meeting held in Glasgow in 1901. The proposal is still under consideration. A cordial invitation from the Lord Mayor of Belfast (Sir Daniel Dixon) to hold a summer meeting in that city has been accepted by the council, and a further invitation, to include a visit to Dublin, has been received from the president of the Institution of Civil Engineers of Ireland (Mr. J. H. Ryan), and has also been accepted. A gold medal of the Institution has been awarded to Captain G. Russo, R.I.N., for his paper on the navipendular method of experiments as applied to some warships of different classes, and a gold medal to Prof. S. Dunkerley, for his paper on the straining actions on the different parts of a crank shaft. Among the numerous papers read during the three days of the meeting the following may be mentioned:—On the effect of modern accessories on the size and cost of warships, Mr. W. H. Whiting; on the lines of fast cruisers, Vice-Admiral C. C. P. FitzGerald; the training of engineers in the United States, Prof. W. E. Dalby; the modification of the mean pitch due to twisting the blades in screw propellers, Prof. Angelo Scribanti; the screw as a means of propulsion for shallow draft vessels, Mr. A. F. Yarrow; marine installations for the carriage of refrigerated cargoes, Mr. R. Balfour; and the corrosion of metal pipes on board ship, Mr. A. W. Stewart.

A demonstration of the Orling-Armstrong system of wireless telegraphy and telephony was given at the Alexandra Palace on Thursday last. We have already referred to this system on several occasions in Nature, and described the capillary relay which is used as a receiver some time ago. The transmitter is so connected that both the primary and secondary circuits of the induction coil are simultaneously earthed, a combination which it is claimed produces remarkable effects. An experiment was shown in which two bombs were exploded at a distance of three or four hundred yards, the earths of the transmitter being about one hundred yards apart; either bomb could be exploded at will, the receiving circuit of each being syntonised to a different period. Syntonisation is effected with a telephonic receiver which actuates a sensitive flame in a tuned chamber; the flame heats a platinum wire in the relay circuit. Presumably, therefore, it is the period of the interrupter which is syntonised, not the oscillation period of the spark; apart from this objection a sensitive flame does not appear a very practical arrangement. Wireless telephony from a distance was also demonstrated; the received speech was plainly audible, but owing to the fact that a key had to be depressed or released for speaking or listening respectively, conversation was not possible; this is, however, a minor difficulty, which can doubtless be overcome. It is

not easy to see how any widespread extension of telephony of the sort could take place without interference, but possibly the principle may be useful for private isolated installations or military and field work generally.

Sir C. Euan-Smith, who presided at the general meeting of Marconi's Wireless Telegraph Co. last week, referred to the wireless telegraph conference which it is proposed should be held in Berlin. He stated that "generally speaking, the company thought that the inauguration of a system intended to be applicable to international wireless communication all over the world, and to be adopted for use by the many more or less imperfect systems of wireless telegraphy in vogue, was fraught with apparently insurmountable difficulties, some of a technical, but others of a business and practical character." They awaited further details of the programme of the conference, however, before forming any definite opinion upon it. Reference was also made to the anticipated arrangement with the Post Office; since that date, according to last Saturday's *St. James's Gazette*, these negotiations have resulted in a further deadlock, the Post Office having imposed conditions which the Company cannot accept. Mr. Marconi also spoke at the meeting at some length, referring mainly to the opposition which his system has met with in the Press; experience had proved, he claimed, that the difficulties, real or imaginary, which had been raised had been overcome one by one, and he hoped that in the near future those still outstanding would likewise be surmounted. Mr. Marconi also spoke of the syntony experiments made by Prof. Fleming, which he hoped shortly to repeat before Lord Kelvin and Lord Rayleigh.

Prof. G. P. Merrill writes from Washington to point out that in the volume entitled "The Elements of Agricultural Geology," by Mr. P. McConnell (Crosby Lockwood and Son), noticed in Nature of November 13, 1902 (p. 31), his work on "Rocks, Rock-Weathering, and Soils" (1897) is misquoted, and he is made responsible for statements which do not appear in the book. Mr. McConnell states (pp. 20–21):—"According to Merrill, the *whole* of the original soil formation of New England has been eroded off by glaciers and dumped into the Atlantic, while a new lot—a mongrel horde—has been brought from the *far* north and laid down." Again, writing of the Huronian formations of the Green Mountains of Vermont, he says (on p. 164):—"As previously stated, an American author holds that the *whole* of the soils originally formed in *this region* have been swept off by glaciers and dumped into the Atlantic." Prof. Merrill informs us that he does not hold and never has held these opinions; and he shows by reference to the original that his words have been misconstrued.

The opal mining industry of Queensland, by Mr. C. F. V. Jackson, forms the subject of Report No. 177 of the Geological Survey of Queensland (1902). While nearly all varieties of opal are found in the western portion of the country, the examples of precious opal there met with are unsurpassed in quality and brilliancy. These examples are found almost entirely in the Desert Sandstone Series (Upper Cretaceous), which has a thickness of from 100 to 200 feet, and so far they have been discovered only in outlying patches of the formation. The Desert Sandstone consists of soft sandstones and clays with a capping of hard siliceous rock, frequently converted into a porcellanite. This "Top Rock" has, in places, a kind of nodular or spherical structure, and there has apparently been a tendency to the solution and redeposition of its siliceous contents. The surface is much disintegrated. The precious opal occurs chiefly in the softer beds underlying the "Top Rock," but occasionally it is found in it. Common forms of opal are prevalent, but the precious variety appears only here and there in patches, sometimes in nodules of siliceous ironstone at all horizons, at other times in the false-bedded sandstones and clays in a more definite band. In places, the mineral is found scattered over the surface, being set free by denudation, but such occurrences furnish little or no evidence of precious opal below. Prospecting is a hazardous business, as the site for a shaft is most frequently chosen in the vicinity where scattered specimens have been found at the surface. The average depth of shafts is 14 feet, and the deepest is about 65 feet. The great difficulty in the progress of the industry is the scarcity of water, the annual output, as the author observes, being dependent on the rainfall.

A treatise by Dr. E. Mazelle, director of the Trieste Observatory, on the connection between the movements of the microseismic pendulum and meteorological phenomena, was recently submitted to the Vienna Academy by Hofrath Dr. J. Hann. The movements of the instrument exhibit a decided yearly period, a maximum in winter and an almost complete absence of disturbance in summer; also a daily maximum and minimum between 9h. and 10h. in the morning and evening respectively. When submitted to harmonic analysis, the whole-day period exhibits a perfect agreement of the phase epoch with that of the stormy Bora at Trieste. The other relations are not so marked; disturbances occur with both days of high and low barometric pressure, but pronounced disturbances appear to be more probably connected with low pressure. With regard to the possible connection of microseismic disturbances with the state of the sea it was found that these have a greater tendency to occur when the sea is rough. For further details we suggest a reference to the work in question.

Dr. T. Byard Collins, writing in the *Scientific American*, describes some experiments on the action of birds' wings. By attaching incandescent lamps to the tips of a pigeon's wing, and inducing the bird to attempt to fly, the path of the tip was found to be an oval curve agreeing fairly well with the results described by Prof. Marey in his "Vol des Oiseaux." The author considers that the only way of solving the problem of flight is by beating wings—a method experimented on many years ago by Pénaud.

A magnetic survey of the neighbourhood of the summit of the Puy de Dôme has led to some interesting results, which are described in this month's *Journal de Physique* by MM. B. Brunhes and P. David. The declination was found to be nearly normal along a line through the centre of the tower, 15° west of north, and it varied from 10° 5′ at 200 metres east of the tower, 80 metres lower than the summit, to 10° 45′ at 300 metres from the tower, 150 metres below the summit. The horizontal component varied from 0·193 of a C.G.S. unit at 100 metres from the tower in a direction 15° west of north to 0·225 of a C.G.S. unit at 156 metres south of the tower. A diagram of the disturbing force shows that it is directed towards the summit, but not quite uniformly in different directions.

In the West Indian *Agricultural News* for March 14 there is a descriptive account of experiments which have been commenced on the Island of St. Vincent with the view of testing the possibility of starting cultivation, with certain plants, on estates which are buried under from nine to ten inches of volcanic ash, resulting from the severe eruptions of the Soufrière in May, September and October, 1902. The plants selected for the experiments are sugar-cane (five

varieties), cotton, ground-nuts, arrowroot and sweet potato. The experiments were started in January, and valuable results were expected, "provided there are no further eruptions." It is to be feared, therefore, that the great quantity of ash thrown out from the Soufrière during the eruption of March 22 last will greatly interfere with the interesting investigation.

The Imperial Department of Agriculture at Barbados has just issued a report giving "Information relating to Cotton Cultivation in the West Indies." Formerly the islands had a valuable export trade in cotton, in 1793 contributing 71 per cent. of the material used in Great Britain, but sugar became paramount, and for about three-quarters of a century past cotton has been practically unknown in the islands. Now that sugar has become to a large extent unprofitable, it is proposed to resuscitate the cotton-growing industry. The department commenced experiments in St. Lucia in 1900, and the results obtained have been so promising that planters there and in neighbouring islands have already devoted about 600 acres to the growth of cotton. So favourable are the conditions that it is stated "the days of the more lucrative production of sugar would appear to have passed away, and it is not improbable but that cotton may once more take its place amongst the staple products of the West Indies."

We have received an official note issued by the Commission of the *Belgica* with reference to the publication of the scientific reports of the expedition. These are to be issued in parts, making ten volumes in all. Only fifty complete sets will be on sale to the public. The English agents are Messrs. Dulau and Co.

M. Charles Rabot contributes an interesting paper on the recent surveys and explorations of MM. Svenonius and Hamberg in Swedish Lapland to the March number of *La Géographie*. Topographical surveys have resulted in important modifications of existing maps, and the region is of great geological interest.

The *National Geographic Magazine* for March contains three articles of considerable interest in relation to the question of the Canadian-Alaskan boundary. The Hon. John W. Foster, who has charge of the presentation of the United States case to the Boundary Commission, reviews the methods by which different parts of the boundary between Canada and the United States have been adjusted since 1783. Mr. Ferdinand Westdahl, of the Coast and Geodetic Survey, gives extracts from his official reports on a survey of the mountains of Unimak Island, Alaska; and an article on the opening of the Alaskan Territory, by Mr. Harrington Emerson, is reprinted in abstract from the *Engineering Magazine*.

The Foraminifera and other organisms in the Raised Reefs of Fiji are described by Mr. R. L. Sherlock (*Bull. Museum of Comp. Zool. Harvard College*, vol. xxxviii. 1903).

We have received the first number of the "Naturalist's Library Guide," a quarterly journal edited by Mr. W. P. Westell, devoted to notices and brief reviews of books and other publications connected with natural history.

Among other zoological papers, the *Sitzungsberichte* of the Royal Scientific Society of Bohemia contains one by Dr. J. Palacký on the distribution of marsupials, and a second, by Dr. H. Matiegka, on the weight of the brain and cranial capacity in man. Much interest attaches to Herr A. Mrázek's account of the discovery of a fresh-water nemertine worm (*Stichostomma graecense*) in Bohemian streams. This paper is followed by a second from the same pen on the introduced faunas of hot-houses.

In his report on the Zoological Gardens at Giza, Cairo, Captain Flower calls special attention to three specimens of that remarkable bird the shoebill, or whale-headed stork (*Balaeniceps rex*), now living in the gardens. With the exception of one specimen, now at Khartum, no other examples, it is believed, have been exhibited in captivity since the pair purchased for its menagerie by the Zoological Society of London in 1860. During the past year an aquarium was opened at Gezira, and contained at the date of the report examples of no less than twenty-two species of Nile fishes.

"Familiar Wild Birds" is the title of a new illustrated work of which we have received the first part from the publishers, Messrs. Cassell and Co., Ltd. It is to be issued in fortnightly sixpenny parts, each of which is to have eight coloured plates. Mr. W. Swaysland is responsible for the greater portion of the text, although Mr. R. Kearton will communicate notes on eggs. The great attraction will be the coloured plates, most of which are to be from sketches by Mr. A. Thorburn. Those in the part before us are really exquisite, and the marvel is how the work is produced at the price.

Pearson's Magazine for April contains two articles, both illustrated, on natural history subjects. In the one Mr. H. F. Witherby describes some of the leading facts connected with bird-migration, in the course of which he draws attention to the important work on this subject carried out by Mr. W. E. Clarke, and likewise points out that it is an error to suppose that the migration routes are narrow. The illustrations include the Nore lightship in the midst of a migratory host, and a "rush" of birds against a lighthouse. It is perhaps not generally known that when such "rushes" take place in stormy weather thousands of birds perish by striking against the lighthouses. On one occasion "the balcony outside was completely covered with killed birds; they were five or six deep all round, so to walk round would be walking on killed birds." In the second article Mr. R. L. Garner reverts to his favourite subject of "monkey-language." From experiments conducted with a phonograph, the author is of opinion that monkeys understand this language as well as human beings interpret words and sentences.

Our best congratulations to the Ulster Fisheries and Biological Association, which was inaugurated at a meeting held in Belfast on March 25, when Lord Shaftesbury, the patron of the new body, was in the chair. The president is Mr. H. H. Smiley, who is a large contributor to the funds, and the Association is fortunate in having secured the gratuitous services of Prof. G. Wilson, of Queen's College, Belfast, as Director, since that gentleman acquired a large experience in matters of this sort during his tenure of office as Inspector of Fisheries in England. .. is expected that the Association will have an important influence on the development of Irish sea-fisheries, which have hitherto been somewhat neglected, as may be judged from the fact that most of the fresh fish sold in Ireland is imported from Great Britain. A steam launch has been already secured, and it is hoped that practical work may be commenced in Larne Harbour forthwith. Although the Department of Technical Instruction and Agriculture has promised a grant of 150*l.*, the Association is in urgent need of additional funds.

The sixth edition of Prof. R. Frühling's "Anleitung zur Untersuchung der für die Zuckerindustrie in betracht

kommenden Rohmaterialien, Produkte, Nebenproduckte und Hilfssubstanzen" has been published by Messrs. Vieweg and Son, Brunswick. The work is a standard one on sugar from the point of view of the technical chemist, and the new edition contains several additions which increase its value.

Messrs. Vieweg and Son, of Brunswick, have issued the third edition of Dr. Robert Fricke's treatise on the calculus and differential equations ("Hauptsätze der Differential und Integralrechnung"). It is writen primarily for use in technical schools, but it contains in the compass of 218 pages the principal subject-matter commonly studied by the average mathematical student, including an appendix on functions of complex variables.

Messrs. J. and A. Churchill have published a sixth edition of "Quantitative Chemical Analysis," by Dr. Frank Clowes and Mr. J. B. Coleman. This edition differs from the last in that the section on organic chemistry has been revised, and processes for determining molecular weight by elevation of boiling point and for the analysis of aluminium alloys have been added. Moreover, to facilitate necessary calculations, tables of four-figure logarithms have been added.

The first number of a new illustrated magazine dealing with scientific subjects, and called *La Science au XX^e Siècle*, has appeared. The magazine is published in Paris, under the editorship of M. G. Maneuvrier, by M. Ch. Delagrave. Judging by the contents of this issue, the new journal should be popular; there are, with others, articles on Mont Pelée, on wireless telegraphy, and on the scientific work of M. P.-P. Dehérain. Attention is also given to the experimental teaching of science in schools, several experiments suitable for school laboratories being described. Applied science receives due attention, and separate sections are devoted to zoology, applied chemistry, botany, physics and photography.

Prof. H. H. Turner, Savilian professor of astronomy in the University of Oxford, contributes to the *Fortnightly Review* for April a reply to Dr. Wallace's article on "Man's Place in the Universe" which was published in the same review last month. Dr. Wallace suggested that the universe is limited in extent; that it has a definite centre at which the solar system is, and has been situated for millions of years; and that by reason of its position the earth has had an opportunity to develop humanity, and probably this opportunity has been nowhere else in the universe. Prof. Turner shows that the limitation of the universe is not proved; that there is no true centre of the universe, even if limited, and even if there were the solar system could not occupy it for long, on account of the sun's proper motion; he also shows that there is no reason whatever why life should not be developed in any part of the interior of even a limited universe.

The new issue, the fortieth, of "The Statesman's Year-Book," edited by Dr. Scott Keltie, is conspicuous for its exhaustive completeness. An examination of its contents suggests that similar annual compilations dealing respectively with the data of each of the great divisions of science would be of great value to men of science everywhere. Dr. Keltie points out that recent important events have necessitated the addition of much further information. Among these occurrences may be mentioned the final incorporation of the two South African Republics in the British Empire, and the passing of the new Education Act. Further details have been embodied of the recent censuses taken in various countries—the British Empire (especially India), France, Germany, and the United States. The maps and diagrams, as usual, add greatly to the interest and value of the "Year-Book." There are maps of the new arbitration boundary between Chile and the Argentine Republic, the new Abyssinian boundary, and the transcontinental railway projects. Diagrams exhibit graphically comparative tonnage of merchant shipping belonging to the principal countries for the past twelve years, comparative outputs of iron-ore and of coal of the principal countries for the last twenty years, the public debt of the principal countries in pounds sterling for the past eleven years, and the emigration from the principal countries for the last ten years.

In following up their researches on chemical affinity at low temperatures, Messrs. Moissan and Dewar describe in the current number of the *Comptes rendus* further experiments on liquid fluorine. Various substances, dried with care, and previously cooled to −190° C. by liquid air with the exclusion of atmospheric moisture, were brought in contact with liquid fluorine also at −190° C. No reaction was observed with iodine, oxygen, tellurium, nitrogen, antimony, carbon, silicon, and boron. On the other hand, sulphur, selenium, phosphorus and arsenic catch fire on contact with the liquid, the reaction with calcium oxide and anthracene being still more violent; potassium, after a short time, gives rise to a violent explosion. It is evident, therefore, that even at this low temperature the forces of chemical affinity are not suspended when so energetic an element as fluorine is concerned.

The additions to the Zoological Society's Gardens during the past week include a Pinche Monkey (*Midas oedipus*) from Colombia, presented by Mr. A. G. Kemp; a Blood-rumped Parrakeet (*Psephotus haematonotus*) from Australia, presented by Mr. B. C. Thomasset; a Sparrow Hawk (*Accipiter nisus*) from Pekin, presented by Mr. W. R. G. Bond; a Moor Monkey (*Semnopithecus maurus*) from Java, ten Olivaceous Lizards (*Lacerta littoralis*, var. *olivacea*) from the Island of Brazza, deposited; a Bactrian Camel (*Camelus bactrianus*), a Mouflon (*Ovis musimon*), a St. Kilda Sheep (*Ovis aries*, var.), five North African Jackals (*Canis lupaster*), born in the gardens.

OUR ASTRONOMICAL COLUMN.

Comet 1902 *d*.—Herr F. Ristenpart gives a daily ephemeris for this comet in No. 3853 of the *Astronomische Nachrichten*. The following is an abstract therefrom:—

12*h*. *M.T. Berlin*.

Date.	α 1903·0 h. m. s.	δ 1903. ° ′ ″	log *r*.	log. Δ	Magnitude
April 10	7 6 22·58	+ 30 37 6·7	0·4447	0·4306	11·76
14	7 11 12·85	+ 31 10 38·1	0·4452	0·4395	
18	7 16 20·11	+ 31 41 34·7	0·4458	0·4482	
22	7 21 43·29	+ 32 9 59·6	0·4465	0·4567	
26	7 27 21·62	+ 32 35 57·0	0·4472	0·4650	
30	7 33 13·88	+ 32 59 29·5	0·4481	0·4731	11·94

An observation made by Herr Millosevich on February 21 gave a correction of −0·91s., −59″·6 to this ephemeris.

Comet 1903 *a*.—The apparent brightness of this comet is now rapidly declining, having reached its maximum value (eighty-two times its brightness when discovered) on March 28. The comet is now too near to the sun in R.A. to be observed, and in any case its great southerly declination would prevent its observation in these latitudes.

An ephemeris published by M. Paul Brück in No. 3851 of the *Astronomische Nachrichten* gives its position for April 13 as α = 0h. 8m. 58s., δ = −41° 5′·6, and its brightness as 36, taking its brightness when discovered as unity.

Variation of Solar Radiation Received on the Earth's Surface.—In a paper published in No. 11 (1903) of the *Comptes rendus*, M. Henri Dufour discusses a series of observations, extending from October, 1896, to March, 1903, which show that the amounts of the solar radiation recorded during December, 1902, and January, February, and the first half of March, 1903, were considerably below the average amounts received during these months, respectively, for the last seven years.

The observations on which the above statement is based were made at two stations about 20 kilometres apart, and during the whole of the period each set of observations has been recorded by the same observer. The observers have used exactly similar instruments, the actinometers of M. Corva, one of which has been verified by the inventor himself and the other checked by it, and the observations exactly corroborate each other.

The figures obtained for December were so small as not to warrant any conclusive statement as to the decreased insolation, but the figures obtained during January, February and part of March corroborate them, and show that for these three months the insolation, per sq. cm., was 0·11, 0·15 and 0·19 (calories—gramme-degrees—minutes) less than the mean for the same months during the past six years.

M. Dufour seeks to explain this decrease by supposing that the atmosphere at the present time contains some matter which is absorbing an abnormal proportion of the solar radiation, and suggests that the volcanic dust thrown out by Mont Pelée may be the cause.

Annals of the Royal University Observatory of Vienna.—Vol. xiv. of these *Annals*, edited by Prof. Edmund Weiss, director of the observatory, contains the detailed results of the observations of minor planets and comets made with the 16·2-cm. Fraunhofer refractor during the period from August, 1895, to January, 1899, and with a 67-cm. Grubb refractor and a 38-cm. equatorial coudé during the years 1897 and 1898.

The tables include the details of the observations of the positions and magnitudes of twelve comets (1895 iii. to 1898 x. inclusive), the positions of twenty-nine NGC nebulæ and one new one, and the positions and magnitudes of many minor planets, including those of Eros observed during 1898.

Vol. xvii. of the same *Annals* contains a "dictionary" of B.D. stars, wherein references are given, opposite each star's B.D. number, to all the other catalogues containing details about the star in question.

A Variable, or Temporary, Star in Lyra.—Herr Seeliger, in a communication to the *Astronomische Nachrichten* (No. 3857), describes and gives a chart showing the position of a faint star (10, 1903, Lyræ) which appears on two plates obtained with the $4\frac{1}{2}$-inch telescope of the Munich Observatory by Herr E. Silbernagel on September 2 and 3, 1902. The star in question occupies the position α = 18h. 48m. 42s., $\delta = +32°\ 39'·0$ (1855), and is about 30s. preceding and 12'·0 south of the Ring Nebula; on the two plates mentioned above it was equal in magnitude to two twelfth magnitude stars between which it is situated, but on plates taken on June 28 and December 10, 1902, on which these two stars are plainly visible, it does not appear. Neither is it shown on any one of thirteen plates, showing thirteenth magnitude stars, obtained with a 6-inch telescope on various dates between July, 1895, and July, 1902, nor does it appear on two plates taken with a 16-inch objective on July 10, 1901, and July 10, 1902, although these plates show stars of magnitudes 15 and $13\frac{1}{2}$ respectively.

Prof. Max Wolf obtained two photographs of this region, one on January 14 and the other on February 6, 1903; the first showed images of stars of the thirteenth magnitude, and the second, which had 2h. 10m. exposure, showed much fainter objects, but on neither plate does the star 10, 1903, Lyræ appear.

In an editorial note appended to Herr Seeliger's notice is a communication from Prof. Hartwig, in which he states that he observed the star 10, 1903, Lyræ on the morning of March 8 (May 7, 16·25h., M.T. Bamberg) with a 10-inch refractor, and found it to be of about the fourteenth magnitude, 0·2m. brighter than its nearest neighbour.

THE FORMATION OF DEFINITE FIGURES BY THE DEPOSITION OF DUST.

It was hardly to be expected that a fine dust when separating out from the air could easily be made to deposit in perfectly sharp, clear, and constant figures, but this is easily done by simply raising the plate, on which the deposit is to take place, a few degrees above that of the surrounding air, and in five to six minutes, in place of a uniform deposit, which would naturally be expected, a perfectly definite figure is formed; the dust will be heaped up in certain places, and in others the plate will be without a trace of deposit upon it. That a plate, bombarded on every side by a thick dust, should be able to compel by means of a very small amount of heat added to it the falling particles to arrange themselves in such definite forms is undoubtedly remarkable.

The active agents in bringing about these results are, no doubt, the currents of air set up round and on the plates, but that their flow should be so regular, so persistent, and so powerful, is more than could have been anticipated. The figures, although very easily formed, are in many cases very complicated, and, notwithstanding the deposit giving a clear and constant record, still at present it remains an unsolved problem how these complicated effects are brought about. Diminished atmospheric pressure does not affect the figures formed.

The material of the plate on which the dust is to settle is not a matter of consequence; it may be of metal, glass, ebonite, india-rubber, or cardboard, and the same figure will be formed, but obviously on some materials the dust will be more visible than on others. A glass plate is probably the best substance on which to receive the deposit, and the best dust to use is that produced by burning magnesium ribbon, for it is brilliantly white, and is readily obtained in any quantity. A glass receiver, or a box of any kind without a lid, will serve as a receptacle for the dust. Light the magnesium and invert the receiver over it, and if sufficient magnesium be used, a dense atmosphere of dust is formed. The plate on which the figure is to form should be raised about an inch above the table on a small support, and then the receiver, filled with the dust, placed over it and left there for six or seven minutes. The plate, previous to placing it in the dust must be warmed; if it be glass, pass it over the flame of a lamp until the moisture, at first condensed on the under side, disappears; other materials may be treated much in the same kind of way, or heated in an air bath. The essential point in order to obtain a good figure is that the plate should be a few degrees, 10° or 15° C., above that of the dust atmosphere. If it be of nearly the same temperature, then the figure is but faint, and the same happens if it be some 100° to 120° above the temperature of the surrounding air, and if of still higher temperature, no deposit of dust takes place.

Suppose now the experiment is made with a square glass plate, treating it as above described; on removing the plate from the dust receiver, most of the dust having subsided, the plate will be found not covered all over with a fine deposit, but a clear and most delicately drawn cross, consisting of four rays, each starting from a corner of the plate and reaching to the centre, is seen. Under the above conditions, the figure is absolutely constant; it may be dense or faint, and it may be slightly distorted by conditions now well known and described, but on a plate of this shape it is always a cross that is formed. The figure starts from the four corners, but vary the form of the plate and you vary the form of the figure deposited on it. The corners being the agents which principally, if not entirely, determine the figure, and in this simplest case a square, it is not difficult to imagine that even the slight heating of the plate is sufficient to start currents of air, which, flowing round the edges of the plate, carry the dust with them, and allow it only to fall where a comparatively still atmosphere exists. In other cases, the flow of the currents seems very difficult to follow, still with such definite and easily produced pictures it may be possible to follow the changes they undergo.

On the square plate, the action of each corner is evident, and this action of corners is still more clearly shown if a plate in the form of an octagon be used (Fig. 1). With a triangular plate, a figure of three limbs is produced, and so on with other shapes, the corners always determine the general figure, and if there be no corners, if the plate be

a circle, no deposit forms. It does not appear as if the composition of the dust used to produce these figures is a matter of importance, the dust from ashes, from ammonium chloride, the fine spores of a fungus, all produce the same figures, but the magnesia produced by burning magnesium is, as before mentioned, more brilliant in colour, and more readily produced than any other dust. There is, however, one essential character necessary in whatever dust is used, namely, that it be very fine.

To obtain these figures perfectly regular in form, care has to be taken that the atmosphere surrounding the plate shall be fairly uniform in temperature. If the reservoir of dust be a glass vessel, and an ordinary Bunsen burner be at a distance of one to two feet from the plate and outside the receiver it is sufficient to spoil the symmetry of the cross by either making one limb of it much thicker than the others or by pushing it more or less on one side. Again, by placing a hot body under the plate while the dust is depositing, curious modifications of

Fig. 1.

Fig. 2.

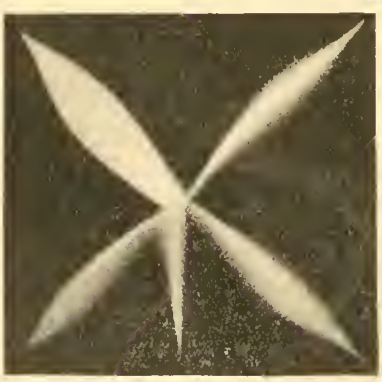


Fig. 3.

Fig. 4.

the deposit are produced, but require the photographic pictures to show exactly what has taken place. At first this extra heating causes an increase of deposit, but when the temperature rises beyond a certain point, it gradually diminishes the amount of deposit, and if the plate rest on a metal support which is at a temperature of about 150° C., no deposit takes place. In fact, for each different way that the heat is applied a different form of deposit is produced. For instance, if the plate be *not* heated, but is placed on a small metal cylinder which is heated, a remarkable deposit is formed; so again when a hot or cold metal cylinder is placed on the top of the plate instead of below it, curious and complicated figures are formed. When the plate is not exactly horizontal, the figures formed on it are no longer symmetrical, but have the appearance of sliding down the plate. Very remarkable effects are produced on these dust deposits by proximity to the plate of different-sized bodies; for instance, stick up a piece of glass against the plate, and then expose it to the dust. The glass screens the plate from the currents of air formed, and a deposit takes place according to the size of the obstruction. Fig. 2 shows what happens when an ordinary pin is placed with its point on a level with a square plate, and at a distance of 3 mm. from it. The cross is still formed, but the pin has caused a realm of calm from the centre towards the edge of the plate. Again, Fig. 3 shows strikingly the delicacy of this kind of action; the fine deposit ending in a fine point was produced by sticking a human hair vertically against the side of the plate and exposing it to the dust atmosphere.

It is then unnecessary for this pin or post to be in contact with the plate; it may be at a distance of some 8 to 10 mm. from the plate. It may be above the level of the plate, on a level with it, or even below its level, and still influences the deposit of dust. In all cases, as the pin recedes from the plate, so does the deposit recede from the edge, getting smaller and smaller, until at last it disappears at the centre. It is difficult to realise that a pin held so that its point is at 6 mm. below the level of the plate and 2 mm. away from it should be able to induce on the plate a definite and decided deposit, but such is the case. In using glass plates for the figures to deposit on, care must be taken that the edges are quite smooth, for if not, the small pieces forming the rough edge of a cut piece of glass are sufficient to cause spikes of deposit to shoot out from the centre on other parts of the figure.

There still remains another way of studying the formation of these singular figures and influencing their formation, by offering obstructions to the free deposition of the dust; for instance, if a strip of glass be placed across a square plate, and the strip be not more than 1 mm. high, the deposit takes no notice of it, and the cross forms as if the strip was not there; but increase the height of the strip, make it 4 or 5 mm. high, and the figure becomes much altered, and the form of the deposit is much changed. Again, if the obstruction to the free flowing of the currents be produced by hanging a strip of glass or a point above the plate to receive the deposit, an interesting series of figures is formed, but these cannot be discussed without the illustrations. Fig. 4 may, however, serve to give some idea of the kind of changes which are produced. This represents a square glass plate with a strip of glass some 25 mm. high, and longer than the plate, placed across it, and a pin pressed against it at the middle of the lower side. The influence of the four corners of the plate, of the pin and of the strip are all clearly indicated; also it will be seen that the right hand ray at the top of the picture has two points, the smaller one is produced by some splinter of glass which was very near to the corner. In the full paper to be printed in the *Phil. Transactions*, there are some fifty pictures showing the formation of different figures.

If the fine powder from burning magnesium is used on a glass plate, it is, when first deposited, easily removed by the slightest touch, but if allowed to remain on the glass for some time, say a fortnight, it becomes comparatively fixed there, and may even be lightly rubbed without being removed.

If mercury in a square vessel be used in place of a solid plate, the same figure of a cross forms upon it. If water be used, entirely different figures form, the sinking of the powder gradually through the water producing other changes.

W. J. Russell.

ON THE FORMATION OF BARRIER REEFS AND OF THE DIFFERENT TYPES OF ATOLLS.[1]

THE results here presented are based upon observations carried on during the past twenty-five years in Florida, the Bermudas, Bahamas, Cuba, Jamaica, and the West Indies in the Atlantic. They include in the Pacific the Galapagos, the Hawaiian Islands, the Great Barrier Reef of Australia, the Fiji Islands, and the Coral Reefs and Islands of the tropical Pacific, from the Marquesas to the Paumotus, the Society Islands, the Cook Archipelago, Niue, the Tonga, Ellice, Gilbert, and Marshall Islands, the Carolines and Southern Ladrones, and the Maldives, in the Indian Ocean.

Recognising that Darwin's theory did not explain the conditions observed, my reports were limited to descriptions of the different types of Coral Reefs and of the causes to which they probably owed their formation, and no attempt was made to establish any independent general theory.

Beginning with the Barrier Reefs, we find that those of Fiji, the Hawaiian Islands, and the West Indies usually flank volcanic islands and are underlaid by volcanic rocks. Those of New Caledonia, Australia, Florida, Honduras, and the Bahamas are underlaid by outliers of the adjoining land masses, which crop out as islands and islets in the very outer edge of the Barrier Reefs. Some of the Barrier Reefs of the Society Islands, of Fiji, and of the Carolines, show that the wide and deep lagoons, separating them from the land mass, have been formed by erosion, from a broad fringing reef flat. Encircling reefs, such as characterise especially the Society Islands, hold to their central island or islands the same relation which a Barrier Reef holds to the adjoining land mass. Denudation and submarine erosion fully account for the formation of platforms upon which coral reefs and other limestone organisms may build, either barrier or encircling reefs, or even atolls, rising upon a volcanic base, of which the central mass may have disappeared as in Fiji, the Society and Caroline Islands.

We may next take the type of elevated islands of the Paumotus, the Fiji, the Gilbert, and the Ladrones, many composed only of Tertiary limestones, others partly of limestone, and partly volcanic. We can follow the changes from an elevated island, like Niue, or Makatea in the Paumotus, to an island like Niau, through a stage like Rangiroa to that of the great majority of the atolls in the Paumotus. The reef-flats and outer reefs flanking elevated islands hold peculiar relation to them; they are partly those of Barrier Reef and partly of Fringing Reef. We may also trace the passage of elevated plateaux like Tonga, Guam, and islands in Fiji, partly volcanic and partly limestone, to atolls where only a small islet or a larger island of either limestone or volcanic rock is left to indicate its origin. Atolls may also be formed upon the denuded rim of a volcanic crater as at Totoya and Thombia in Fiji, as well as in some of the volcanoes east of Tonga.

In the Ellice and Marshall group and the Line Islands, are a number of atolls, the underlying base of which is not known and where we can only follow the formation of the land rim of the atoll, as far as it is due to the agency of the trades or of the monsoons in constantly shifting the superficial material (prepared by boring organisms) which goes to form its rim. Many of the atolls in the Pacific are merely shallow sinks, formed by high sandbanks, thrown up around a central area.

Throughout the Pacific, the Indian Ocean, and the West Indies the most positive evidence exists of a moderate, recent elevation of the coral reefs. This is shown by the horses, pinnacles, and undermined masses of modern or Tertiary limestone left to attest it. The existence of honeycombed pinnacles of limestone within the lagoons of atolls, as shoals, islands, or islets, shows the extent of the solvent action of the sea upon land areas, having formerly a great extension than at the present day. Signs of this solvent action are to be seen everywhere among coral reefs. Atmospheric denudation has played an important part in reducing elevated limestone islands to the level of the sea by riddling them with caverns and by forming extensive sinks, often taken to be elevated lagoons.

[1] By Alexander Agassiz, For. Mem. R.S. Read at the Royal Society, March 19.

Closed atolls can hardly be said to exist; Niau in the Paumotus is the nearest approach to one, yet its shallow lagoon is fed by the sea through its porous ring. Sea water may pass freely into a lagoon at low tide over extensive shallow reef flats where there are no boat passages. The land area of an atoll is relatively small compared to that of the half-submerged reef flats. This is specially the case in the Marshall Islands and the Maldives where land areas are reduced to a minimum.

The Maldivian plateau with its thousands of small atolls, rings, or lagoon reefs, rising from a depth varying from twenty to thirty fathoms is overwhelming testimony that atolls may rise from a plateau of suitable depth, wherever and however it may have been formed and whatever may be its geological structure. On the Yucatan plateau similar conditions exist regarding the formation of atolls, only on a most limited scale.

The great coral reef regions are within the limits of the trades and monsoons and areas of elevation, with the exception of the Ellice and Marshall Islands and some of the Line Islands. The extent of the elevation is shown by the terraces of the elevated islands of the Paumotus, Fiji, Tonga, Ladrones, Gilbert, and West Indies, or by the lines of cliff caverns indicating levels of marine erosion.

In the regions I have examined the modern reef rock is of very moderate thickness, within the limits of depth at which reef builders begin to grow and within which the land rims of atolls or of Barrier Reefs are affected by mechanical causes. This does not affect the existence of solitary deep sea corals, of extensive growths of Oculina or Lophohelia at great depths, or in any way challenge the formation of thick beds of coraliferous limestone during periods of subsidence.

The Marquesas, Galapagos, and a few islands in the Society and West Indies have no corals, although they are within the limits of coral areas. Their absence is due to the steepness of their shores and to the absence or crumbling nature of their submarine platforms. Coral reefs also cannot grow off the steep cliff faces of elevated, coraliferous limestone islands.

Corals take their fullest development on the sea faces of reefs; they grow sparingly in lagoons where coralline algæ grow most luxuriantly. Nullipores and corallines form an important part of the reef-building material.

UNDERGROUND WATERS.

"THE Motions of Underground Waters" is the title of an essay by Mr. Charles S. Slichter, and it is issued as No. 67 of the Water Supply and Irrigation Papers of the United States Geological Survey. The author, in the first place, discusses the origin and extent of underground waters, remarking that these are included only in the zone of saturated rocks, the surface of which is known as the *water table* or *water plane*. The lowest depth at which ground waters can exist is regarded as approximately six miles. The region above this limit is distinguished as the zone of fracture, for in it pressures and stresses result in the breaking of the rocks. Below, all cavities and pores in the rock are completely closed. The amount of ground water within the crust of the earth is estimated to be nearly one-third the amount of the oceanic water, and to be sufficient to cover the entire surface of the earth to a uniform depth of from 3000 to 3500 feet. But these "waters under the earth" are, of course, only recoverable in useful quantities at limited depths; even the thermal springs arise from a level much above the geologic limit of depth.

Attention is directed to the fact that water is found in notable quantities in crevices of schists and gneisses, as in the St. Gothard tunnel; but the greater part met with in rocks is stored up in the minute pores and openings between the rock particles themselves, in sands, sandstones and limestones, in clay loams, while even the strongest rocks, such as the Montello granite, are measurably porous.

The author then discusses the cause and rate of movement of water through the strata, according to the size of the pores, the pressure and the temperature, the flow being noticeably greater for high than for low temperatures. This subject is illustrated by microscopic sections of rocks,

and the author then passes on to the laws of flow, as determined by the length, shape and number of the openings between particles. In the mechanical analysis of soils, the mean diameter of the grains is known as the *effective size*, and is such that if all grains were of that diameter, the soil would have the same transmission capacity that it actually has. The effective size is determined from the dimensions of the mesh of a sieve which will permit 10 per cent. of the sample to pass through it, but will retain the other 90 per cent. That is, in any soil, 10 per cent. of the grains are smaller than the effective size and 90 per cent. are larger. It is remarked that the velocity of flow through porous strata is much less than might at first be supposed. In the sands of the Dakota formation, from which remarkable artesian wells draw their supply, the flow does not exceed a mile or two a year.

Underground waters are divided into three principal zones:—(1) The unsaturated zone, (2) the surface zone of flow, and (3) the deeper zones of flow. The motion of water in the unsaturated zone is essentially vertical—downward in supplying the saturated sheet below, and upward in supplying the surface evaporation and the requirements of vegetation by means of the capillary action of the soil during rainless periods.

The surface or upper zone of flow extends from the level of the water table to the first impervious rock floor. The deeper zones of flow are those that lie below the first impervious stratum, and the direction and character of the

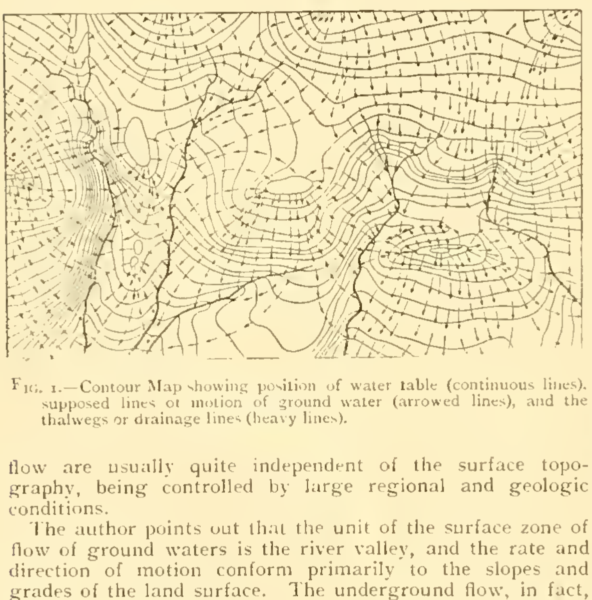


Fig. 1.—Contour Map showing position of water table (continuous lines), supposed lines of motion of ground water (arrowed lines), and the thalwegs or drainage lines (heavy lines).

flow are usually quite independent of the surface topography, being controlled by large regional and geologic conditions.

The author points out that the unit of the surface zone of flow of ground waters is the river valley, and the rate and direction of motion conform primarily to the slopes and grades of the land surface. The underground flow, in fact, follows the trend and direction of the surface drainage. The water table has a slope which is essentially similar to the slope of the surface of the ground, though less steep. The motion of the underground seepage into the streams and rivers is similar to the lines followed by the surface drainage into the same streams.

The lowest line of drainage of the valley is known technically as the *thalweg*. Topographically, it is a line upon a contour map which is a natural water-course (Fig. 1). Beneath the thalweg there is usually a similar drainage line for the underground current, in general coincident with the thalweg. For other parts of the valley the actual lines of motion of the underground water are represented by a set of curves which cut the contour lines of the water table at right angles. The similarity of the contours of the water table to those of the land surface enables one to sketch approximately the lines of underground seepage from a contour map of the surface. For the most part the lines of flow run into the surface streams or thalwegs, but between A and B, and X and Y, there is indication of an underflow or general movement in the direction of the surface streams and independent of the same.

These views are worthy of attentive consideration and study in connection with the geological structure, for, as the author justly remarks, they must not be taken too literally. The surface topography is only one, and often not the most important, element in the control of the underground current. He points out how irregularities in the form of the first impervious layer and the amount of rainfall will influence the distribution and motion of the ground water. He directs attention also to the fact that much ground water returns to the surface in the form of seepage which is more important, though less obvious, than the springs. Much ground water, moreover, may not find its way immediately into open channels, but may even take a general course down the thalweg and flow through coarse materials toward the sea in large underground streams or moving sheets of water. This underflow is well known in the Great Plains of America, although the movement is excessively slow. Sometimes the underflows appear to be independent of the surface streams, as indicated by chemical analyses.

The deep zones of flow and artesian wells are finally discussed by the author; he deals also with common dug wells and the influence of pumping on contiguous wells, as well as the mutual interference of artesian wells. H. B. W.

LONDON FOG INQUIRY, 1901–02.[1]

In November, 1901, the Meteorological Council appointed Captain Carpenter, R.N., D.S.O., a member of the council of the Royal Meteorological Society, to conduct an inquiry into the occurrence and distribution of fog in London, initiated, with the assistance of a grant from the County Council, in response to requests for more detailed forecasts of the occurrence of fog. Captain Carpenter at once put himself into communication with Captain Wells, R.N., the chief officer of the Metropolitan Fire Brigade, and made arrangements for the systematic observation of fogs at some of the river stations and at other stations of the Metropolitan Fire Brigade. He also arranged for supplementary observations to be taken at certain of the Metropolitan Police stations, at Battersea Park and Regent's Park, at a number of coast-guard stations in the Thames estuary, and by one or two private persons. Observations of temperature and other meteorological conditions were obtained from a number of the stations and from the parks; self-recording thermometers were installed on the Victoria Tower at Westminster, the Golden Gallery at St. Paul's, on the roof of the Meteorological Office and at a private house at Banstead. Regular records of fog in accordance with a conventional scale distinguishing the kind and intensity of the fog were thus obtained from a series of points in or round London. By arrangement with Captain Wells, special observations were made during fog or when fog was anticipated by the forecast branch of the Meteorological Office.

Attention may be called to the following points in Captain Carpenter's report, which is now issued:—

(1) The first result of the inquiry is the suggestion of a scale of fog intensity, arranged according to the interference with traffic upon road, rail, river, or sea, and represented by the serial numbers 0 to 5.

(2) Next it appears that on account of smoke the extreme limit of visibility in winter from an elevated position in London, in most favourable circumstances, is set at 1½ miles. That limit is diminished as the tendency to form fog is developed until the well-known effects of dense fog are reached.

(3) No evidence has been obtained of any special connection between fogs and geological conditions.

(4) The commencement of a fog is not identified with any particular locality; it seems to be a general process depending upon general atmospheric conditions. There is no evidence that fogs formed outside invade or drift into London. The London fogs are produced in London; they do not come from the country.

(5) The meteorological conditions for the formation of fog are set forth and illustrated by charts and diagrams. An interesting point brought out is a tendency to indraught

[1] Report to the Meteorological Council by Captain Alfred Carpenter, R.N., D.S.O.

of air from all sides to the central parts of London during dense fogs.

(6) No severe fog occurred with an air temperature above 40° F. The minimum air temperature prior to fog coming on averaged 9° below the normal mean temperature for the day. The relation between the occurrence of fog and the minimum temperature in November and December, 1901, is shown in Fig. 1.

(7) During the period of observations, in twenty-two cases out of twenty-five during the nights preceding days of fog, a thermometer on the grass at Regent's Park fell much below the river temperature, the amounts of difference on these occasions varying from 6° to 25° F.

Attention is called to one point of special importance in connection with temperature observations, which requires to be followed up. On March 7, during fog, the temperature in the streets of London was nearly 10° F. below that on the roof of the Meteorological Office, the elevated stations, and the surrounding country on the southern and western sides.

The outstanding parts of the inquiry are :—

(1) To ascertain whether the proposed scale of classification of fogs puts the observations of locality upon a more satisfactory footing, and whether additional observations throw any further light on local distribution.

(2) The further investigation of temperature conditions, including temperature observations in the early morning (5 a.m.), and vertical distribution of temperature.

With regard to the last point, we learn that an opportunity was recently afforded for determining the conditions

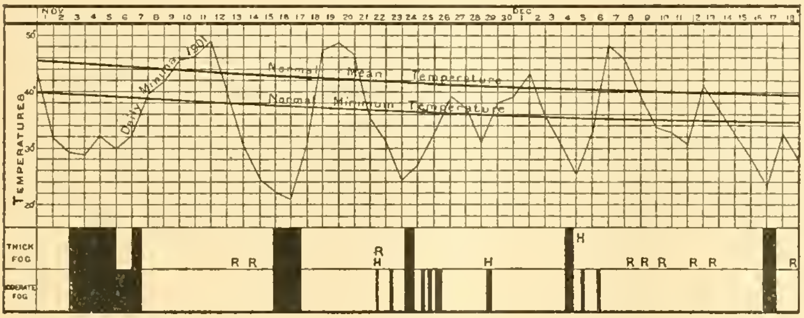


Fig. 1.—Part of diagram showing the occurrence and duration of fog in London and the daily minimum of temperature at Kew. H signifies "high fog," R a rainfall of 0·05 inch or more.

under which such investigation could be carried out in London by the loan of a captive balloon and self-recording instruments. Captain Carpenter was himself unable, on account of his health, to continue the conduct of the inquiry beyond the close of the winter of 1901–2. The conclusions drawn in his report are based exclusively upon observations during that period, and are expressly subject to possible revision in the light of further observations. At his suggestion the observations were recommenced in September, 1902, and have been continued during the winter; they include a number of special observations of temperature at 5 a.m. The continuation of the inquiry has been under the superintendence of Mr. R. G. K. Lempfert, of the Meteorological Office.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

The annual exhibition of scholars' work from the Board Schools of London will be held at the Examination Hall, Victoria Embankment, W.C. (adjoining Waterloo Bridge), on Saturday, May 9, and on the following Monday, Tuesday and Wednesday (May 11–13). The exhibition will be opened by Lord Reay (chairman of the Board), and will include among the exhibits specimens of modelling, science apparatus and metal-work from the day and evening schools, and also work from the schools for the blind, deaf, special instruction, truant, and industrial schools.

The council of Owens College, Manchester, has, under a scheme of the Board of Education, resolved to establish a scholarship and exhibition in zoology and botany out of the accumulations of the Robert Platt fund, which has hitherto been applied only to physiology. The scholarship will be of the yearly value of 50*l.*, will be open for competition to persons who have studied zoology or botany in any university or college laboratory, and will be awarded to the candidate who shows most promise and ability for the prosecution of research in zoology or botany.

An interesting ceremony took place at the gardens of the Royal Botanic Society on Wednesday, April 1. The Earl of Aberdeen presided, and Mr. Alfred James Shepheard, chairman of the Technical Education Board of the London County Council, declared the newly erected laboratory open for botanical and horticultural work. Instruction on the lines of the syllabus of the Board of Education will be given in botany, and attention will also be paid to horticultural chemistry, elementary and advanced, in connection with the practical gardening school. Other classes will, if necessary, be carried on and research work undertaken. The school of which the laboratory is the outcome was, as Dr. C. Adams pointed out at the opening ceremony, started five years ago with nine students; now there are thirty-five—of whom twenty-one are boys and fourteen girls. Some 2000*l.* has been spent over the undertaking, of which the Technical Education Board has provided 850*l.* The work has been very successful, and no difficulty has been found in obtaining appointments for the students who have been through the three years' course. Mr. Shepheard in his speech pointed out that to endeavour to grow plants with only practical knowledge was like attempting to cure the sick after the fashion of a quack doctor, without having mastered the science of medicine. Miss Shepheard presented diplomas to successful students at the school, and Dr. Kimmins, Dr. Garnett and Mr. Brinsley Marlay also spoke. The Royal Botanic Society is decidedly to be congratulated upon adding theoretical instruction to the practical teaching already carried on, though it seems advisable that the special principles underlying horticultural practice should figure in the syllabus as well as pure botany.

The Education Bill for London was introduced in the House of Commons on Tuesday. It is proposed to make the London County Council the education authority, so that the London School Board will disappear. The new education committee will contain ninety-seven members, this total being made up as follows :—Representatives of the borough councils—one for each borough and two each for Westminster and the City of London—31; London County Council, 36; representatives (including women) of various secondary schools, the University of London, technical institutions and bodies contributing to the maintenance of education, 25; and (for the first five years) representatives of the London School Board, 5—total 97. The object of the Bill is thus to abolish the School Board, and to link education in London with municipal government. The County Council, as the education authority, is to have the rating powers of a county borough under the Education Act of 1902. The management of public elementary schools is to be entrusted to the borough councils, subject to the general direction of the education authority, which is to have complete financial control. The borough councils are to have the right to appoint and dismiss teachers, the custody of the buildings, and the right to select the sites for new schools in their prescribed areas. These powers, however, do not apply to secondary schools and technical institutions.

A Birmingham correspondent describes in the *Times* for April 2 the four great German commercial high schools, those namely at Aachen, Cologne, Frankfurt, and Leipzig. There is a special appropriateness just now about such a

study, since during the present period of organisation and development at the University of Birmingham it is of importance that those responsible for its new commercial department should be intimate with German experience. It is not sufficiently remembered, the writer of the article insists, that these German institutions are new and in an experimental stage, that they are characterised by great diversity of organisation, and are the outcome, not of Governmental initiative, but of the demands of the commercial classes; in most cases, indeed, their financial basis was provided by private generosity and municipal support, not by grants from the State. At Aachen, where the commercial "course" is simply a department of the technical college, the authorities abide by the general rule for admission to universities and technical colleges, and refuse to receive into full membership any who have not passed the leaving examination of the Gymnasia, Realgymnasia, or Ober-realschulen. In most cases the certificate is not secured until nineteen. The three other institutions admit men who have left school three years earlier (with the certificate shortening their military service to one year), on condition that they have spent the three following years in an apprenticeship or in some definite business experience. At present the Aachen plan is hardly practicable, and tends to restrict the numbers. "The German movement is," the article shows, "full of interest and instruction for foreign observers. Its ideals are rising; and the two years which form the present period of study are already beginning to seem inadequate. There are grave difficulties to be met; but an amount of ardour, of ability of a high order, and, what is not unimportant, of money also, is being devoted to the task, which ought to sting a reflective Englishman with a sense of shame."

SCIENTIFIC SERIAL.

Biometrika.—The last three numbers continue to record results of high biological interest. The excellence of Prof. Karl Pearson's elaborate studies in statistical theory is becoming widely recognised, and his comments and criticisms add much to the value of the work of other contributors. In vol. i. part iv. Mr. F. Galton states a new problem in the variation of a population with respect to a given character, which, generalised in a note appended by Prof. K. Pearson, is seen to be likely to have important results in statistical inquiry.—The same part contains an attempt by Dr. J. Y. Simpson, good as far as it goes, to demonstrate the inequality of results in the binary fission of the Protozoa. Dr. Simpson's conclusions so far recall those of Maupas, but the difficulties in the way of a successful investigation of this problem are extreme, and it cannot be said that he has met every possible objection. The inquiry is obviously of importance for the general theory of variation, and it is to be hoped that in spite of their difficulty the observations will be continued.—The thorough-going study of the Naqada crania carried out by Miss Fawcett with the help of Miss Alice Lee and other biometric students at University College occupies the bulk of the present issue, and the part concludes with a careful research, by C. Hengsen, on the variations of *Helix nemoralis*.—The subject of gasteropod shells (*Nassa obsoleta* and *N. trivittata*) also finds a place in the opening part of vol. ii., in which number will likewise be found Prof. Weldon's strictures on the ambiguity of some of Mendel's categories, *e.g.* "green" and "yellow" as applied to the cotyledons of peas.—The co-operative paper on inheritance in the Shirley poppy marks another long step towards the establishment of a working theory of heredity, the results reached being in general accordance with Galton's law.—Among the "Miscellanea" may be noted Mr. Whitehead's paper on variation in *Adoxa moschatellina*, and the first instalment of what promises to be a most important series of test experiments, by Mr. Darbishire, in the Mendelian theory of heredity. Japanese "waltzing mice," the colour of the coats of which is white with patches of pale fawn, were crossed with European albinos, the hybrids being crossed *inter se* and also with the albino parent stock. These experiments, some later results of which are recorded and discussed in vol. ii. part ii., have yielded data which are by no means easy of interpretation, and their further outcome will be awaited with keen interest. One remarkable result is that every hybrid of the first generation was dark-eyed, though the eyes of all the parents were pink. In a certain proportion, however, of the progeny of the first hybrids the pink eyes reappeared, as did some other parental characters. A recent letter in NATURE shows that Mr. Bateson, at all events, is not disposed to admit that the facts so far obtained are discordant with Mendel's law, but it must be allowed that much of the evidence is *primâ facie* in favour of ancestral inheritance.

SOCIETIES AND ACADEMIES.

London.

Physical Society, March 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—On refraction at a cylindrical surface, by Mr. A. **Whitwell**. The object of the paper is to describe and illustrate the position and form of the focal areas produced by the refraction, at a cylindrical surface, of light diverging from or converging to a point. In general, if a plane can be drawn through the point to cut the surface symmetrically, then all the light passes really or virtually through an area in this plane. In the case of the cylinder there are two such planes. One contains the radiant point and the axis of the cylinder, the other contains the point, and is normal to the axis. The equation of the locus of intersections of symmetrical rays which intersect in the first plane, for small apertures, is obtained in terms of the distance of the radiant point from the axis of the cylinder a, the radius r, and the index of refraction μ. The loci of the intersections of symmetrical rays which intersect in the second plane, when the aperture is small, are shown to be circles described about the radiant point as centre and having radii equal to $(\mu-1)(a-r)$.—The evaluation of the absolute scale of temperature, by Dr. R. A. **Lehfeldt**. Formulæ are given for the constant-pressure and constant-volume thermometers. An attempt is made to work out the latter with the aid of existing data. It is found that $T_0=273{\cdot}18$ from hydrogen and $273{\cdot}2$ from nitrogen. The deviation of the constant-volume scale from the absolute scale is indicated by curves. At 100° absolute the constant volume (hydrogen) thermometer reads 0·1 or 0·2 too low.—Prof. **Callendar**, in a communication sent subsequent to the meeting, said that in his paper on the thermodynamical correction of the gas thermometer (*Phil. Mag.*, January) he had incidentally mentioned that the correction for the constant-volume gas thermometer could not be directly deduced from the Joule-Thomson cooling-effect alone, without additional data, unless a formula were assumed for the variation of the cooling-effect with temperature; but that the value of the absolute zero could be deduced from the pressure coefficient if the Joule cooling-effect in free expansion were known. The experimental measurement of the latter was, however, impracticable.—Mr. **Blakesley** exhibited and described a lens possessing the following properties:—The two conjugate foci always move with the same relative rate along the axis. The size of the object always bears to the size of the image the same ratio, so that using the same object the image is always of the same size. The instrument is of one piece of glass, and constitutes a telescope the magnifying power of which is the ratio which the object bears to the image in size, linear. The relation of the rate of motion of the object to that of the image is the square of the magnifying power.

Chemical Society, March 18.—Prof. J. Emerson Reynolds, F.R.S., president, in the chair.—The following papers were read:—Essential oil of hops, by Mr. A. C. **Chapman**. This oil consists principally of two terpenes, one being identical with that present in oil of bay, and named by its discoverers myrcene, and the second a sesquiterpene, which has been named humulene; there are present in addition to the foregoing small quantities of the odoriferous alcohols linalool and geraniol, the latter being present in the form of its isononoic ester.—A compound of dextrose with aluminium hydroxide, by Mr. A. C. **Chapman**. When dextrose dissolved in alcohol is treated with aluminium chloride there separates a white amorphous compound of the formula $3C_6H_{12}O_6,5Al_2O_3,11H_2O$.—Action of phosphorus haloids on dihydroresorcins. ii. Dihydroresorcin,

by Messrs. **Crossley** and **Haas.** A description of the derivatives obtained by the action of phosphorus tri- and pentachlorides on dihydroresorcinol.—The constitution of cotarnine, by Messrs. **Dobbie, Lauder** and **Tinkler.** The authors have examined the ultra-violet absorption spectra of solutions of this alkaloidal derivative in various solvents in order to ascertain which of the three formulæ assigned to the base most probably represents its constitution; the observations show that in the solid state cotarnine has the formula *a*, and that on solution in alcohol is converted into the coloured isomeride having the formula *b*.

$$C_8H_6O_3\begin{cases} CH.OH—NMe \\ \quad\quad a \quad\quad\ | \\ CH_2———CH_2 \end{cases} \longrightarrow C_8H_6O_3\begin{cases} CH{=}NMe.OH \\ \quad\quad\quad | \\ CH_2—CH_2 \end{cases}$$

—Decomposition of mercurous nitrite by heat, by Dr. P. C. **Rây** and Mr. J. N. **Sen.** The products of this reaction are mercuric nitrate, metallic mercury, nitric oxide and peroxide. —The action of nitrogen tetroxide on pyridine, by Mr. J. F. **Spencer.** The first product of this reaction is a molecular additive compound, but eventually there is formed a yellow substance of the composition $(C_5H_4O_2N_2)_4$, and a purple product of still more complex constitution.

Entomological Society, March 18.—Prof. E. B. Poulton, F.R.S., president, in the chair.—The Rev. F. D. **Morice** exhibited with drawings a dissected gynandromorphous specimen of a bee (*Osmia fulviventris*, Panz.).—Mr. A. **Bacot** exhibited a number of specimens of *Malacosoma neustria* × *castrensis* in various stages, including a series of six ♂ ♂ and sixteen ♀ ♀ imagines reared during 1902 from one batch of ova laid by a ♀ Castrensis, which had been mated with a ♂ Neustria, and two ♀ ♀ reared from another batch of ova the result of a similar cross; also blown larvæ of hybrid parentage, and twigs showing attempts at ovipositing on the part of ♀ ♀ hybrids that had paired with hybrid ♂♂ of the same brood; also a series of *M. Neustria, M. Castrensis* and the hybrid moths reared during 1901 for comparison.—Mr. H. St. J. **Donisthorpe** exhibited specimens of *Trimium brevicorne,* Reich., from Chiddingfold, Surrey, an unusually southern locality for this species.—Mr. C. P. **Pickett** exhibited specimens of *Hybernia leucophaearia* and *Phigalia pedaria* taken at Chingford on February 14, and ova of *Endromis versicolora* on birch twigs, laid March 16. —Mr. G. C. **Champion** exhibited a long series of specimens of a species of *Cneorrhinus* (*? pyriformis*) from Piedrahita, Spain, and called attention to the great dissimilarity between the sexes, and also to the possibility of the females being dimorphic, one form clothed with green scales, and the other with grey scales like the male. He also exhibited *Dorcadion dejeani*, Chevr., from the Sierra de Bejar, a species peculiar to that district.—Mr. R. **McLachlan,** F.R.S., exhibited a dragonfly belonging to a small species of the genus Orthetrum, attacked by a fly almost as large as itself of the family Asilidæ, taken in Persia in June, 1902, by Mr. H. F. Witherby. The fly had inserted its proboscis at the junction of the head and prothorax, a vulnerable point. He also exhibited a female specimen of a large Æschnid dragonfly, *Hemianax ephippiger*, Burm., captured in a street at Devonport on February 24. The species occasionally visits Europe in migratory swarms or sporadically, but is especially African, and its presence at Devonport in February might probably be due to the example having flown on board a vessel off the African coast. Mr. F. Merrifield suggested that there might be some connection between the appearance of the insect in England and the reported showers of fine dust which are generally supposed to have come from the Sahara.—Prof. E. B. **Poulton**, F.R.S., exhibited seasonal forms of *Precis antilope,* parent and offspring, bred by Mr. G. A. K. Marshall in South Africa, and *Precis coelestina*, from the Victoria Nyanza region, with the dry-season form of that species, now taken probably for the first time.—Mr. W. J. **Lucas** exhibited with the lantern a slide showing the larva of *Cossus ligniperda* in its gallery in a tree trunk.—Dr. T. A. **Chapman** exhibited with the lantern a series of slides illustrating the life-history of *Liphyra brassolis*, Westw., a Queensland species, the larva of which lives in ants' nests, and feeds upon the ant-larvæ. The imago on emergence from the pupa is clothed with scales highly distasteful to the ant, which protect it during emergence from attack, and until such time as it is able to fly, when they drop off.—Mr. G. C. **Champion** read a paper on an Entomological Excursion to Bejar, Central Spain.—Dr. F. A. **Dixey** read a paper, illustrated by lantern slides, on Lepidoptera from the White Nile, collected by Mr. W. L. S. Loat; with further notes on seasonal dimorphism in butterflies.—Mr. E. **Saunders,** F.R.S., communicated a paper on Hymenoptera Aculeata collected by the Rev. A. E. Eaton in Madeira and Teneriffe, in the spring of 1902.

Royal Microscopical Society, March 18.—Dr. H. Woodward, F.R.S., in the chair.—Mr. J. W. **Gordon** gave an account of his paper on the Helmholtz theory of the microscope, which contained a rough sketch of the theory of diffraction, and considered this from a new point of view, expanding the Helmholtz theory from this position. The paper then dealt with the Helmholtz theory, starting with the proof of the sine law as given by Helmholtz. Having proved the sine law, Helmholtz made deductions from it, and drew the inference that the resolving power of the most perfect optical system must necessarily stop short at an object which was less than half a wave-length of the light by which its observation was attempted. Mr. Gordon then proceeded to set out the points of his own paper, including a description of some vibrating screens by the aid of which the definition of high powers was much improved, when the image was greatly super-amplified by eye-piece magnification.

Linnean Society, March 19.—Prof. S. H. Vines, F.R.S., president, in the chair. Mr. Clement Reid exhibited drawings by Mrs. **Reid** of fruits and seeds of British pre-Glacial and inter-Glacial plants (Thalamifloræ). In each case the specimens illustrated were the earliest known representatives of the species. Most of the plants are still living in Britain; but among the Thalamifloræ from the Cromer Forest-bed occur seeds of Hypecoum, a genus specially characteristic of the Mediterranean region, and no longer found living nearer than Southern France. The fossil seeds correspond closely with the living *Hypecoum pendulum* of Southern France, and either belong to that species or to a closely-allied extinct form. The seeds of all the species of Hypecoum are covered by a curious close mosaic of cubic crystals, apparently calcium oxalate, which fill square pits in the surface of the testa. Traces of these pits are still found on some of the fossil seeds.—Mr. G. Claridge **Druce** read a paper on *Poa laxa* and *Poa stricta* of our British floras. For some years past, doubts have been expressed by critical botanists as to the correct naming of these two plants. The author's conclusions are, that the plants named *Poa alpina*, var. *acutifolia*, and *P. laxa*, var. *scotica*, have been misunderstood and variously named; he therefore gives detailed descriptions of these two plants, with synonymy so far as British floras are concerned. The paper was illustrated by specimens from the author's herbarium, and the type-specimen of *Poa flexuosa* from Smith's herbarium.—The botany of the Ceylon patanas, part ii., by Messrs. J. **Parkin** and H. H. W. **Pearson.** In a former paper on the same subject (Pearson, *Journ.* Linn. Soc. Bot., vol. xxxiv. 1899, pp. 300–365) the main features of these grassy uplands, locally known as "patanas," were given, the probable causes which have led to their development discussed, and the general biological characters of their flora described. An account of the anatomical examination of the plants collected was promised for a separate paper; this communication is the fulfilment of the promise.

Paris.

Academy of Sciences, March 30.—M. Albert Gaudry in the chair.—On affinity at low temperatures; the reactions of liquid fluorine at $-187°$ C., by MM. H. **Moissan** and J. **Dewar** (see p. 544).—On the alkyl- and acyl-cyanocamphors and the alkylcamphocarbonic esters. The influence of the double linkage of the ring containing asymmetric carbon on the rotatory power of the molecule, by M. A. **Haller.** The enolic and ketonic forms are simultaneously produced in the formation of derivatives of cyanocamphor, which are distinguished by their behaviour on treatment with hydrochloric acid. Measurements of the rotatory power showed that higher values were always given by the enolic forms than with the ketonic forms.—Problems in biological energetics, raised by a note of Lord Kelvin on the regulation of the

temperature of warm blooded animals. The permanence of the processes producing heat of combustion, by M. A. **Chauveau.** In searching for a means of explanation of the constancy of temperature of an animal when placed in a medium at a higher temperature than the normal, the suggestions of Lord Kelvin are subjected to an experimental examination; it was found that under the experimental conditions of Crawford, venous blood is neither poorer in carbonic acid nor richer in oxygen; the expired air under the same conditions contains practically the normal amounts of oxygen and carbonic acid. There is thus no reason to suppose the existence of endothermic reactions in animals placed in a medium warmer than their normal temperature.—Remarks by M. Edmond **Perrier** on a work on embryogenic acceleration.—Prof. Ray **Lankester** communicated to the Academy two drawings of the head of a gigantic mammal recently discovered in the Upper Eocene Sands at Fayum, Egypt.—M. de Forcrand was nominated a correspondant in the section of chemistry in the place of the late M. Reboul.—On an eruption of the volcano at St. Vincent, by M. A. **Lacroix.**—On a mechanical calculator called the arithmograph, by M. **Troncet.**—On the absolute temperature deduced from the normal thermometer, by M. H. **Pellat.** As a first approximation, it is shown that the usual formula for the absolute temperature gives results about 0·11° C. too low.—The action of hydrogen on the sulphides of arsenic in presence of antimony, and on the trisulphide of antimony in the presence of arsenic, by M. H. **Pelabon.** Antimony completely displaces arsenic in its sulphides if the two bodies are in the liquid state. Hydrogen gas, heated in presence of sulphide of antimony and a mixture of arsenic and antimony, forms hydrogen sulphide, the proportion of which increases with that of the arsenic in the mixture.—On pyrophosphorous acid, by M. V. **Auger.** Crystals of pyrophosphorous acid can be obtained by shaking together for some time a mixture of phosphorous acid with an excess of phosphorus trichloride.—On the action of phosgene on the organo-magnesium compounds, by M. V. **Grignard.** Either a symmetrical ketone or a tertiary alcohol can be obtained, according to the experimental conditions.—New researches on the decomposition of organic acids, by MM. Oechsner **de Coninck** and **Raynaud.** Various organic acids have been heated with strong sulphuric acid and with glycerol, and the conditions under which carbon monoxide and dioxide are given off have been determined.—The constitution of the nitrocelluloses, by M. Léo **Vignon.** The nitrocelluloses, reduced in acid solution by ferrous chloride, give oxycellulose. This reaction clearly differentiates cellulose from mannite and other polyatomic alcohols which have been previously studied from the point of view of nitration.—On the nitrogen compounds contained in arable earth, by M. G. **André.**—Remarks on the general morphology of the muscles, by M. J. **Chaine.**—On the fishes of the family of Atherina in Western Europe, and on the connection between their species, by M. Louis **Roule.**—The structure of the rootlets in *Trapa natans*, by M. C. **Queva.**—On the problematic bodies and the Algæ of the Trias in Lorraine, by M. P. **Fliche.**—The defence of the organism in the newly-born, by MM. A. **Charrin** and G. **Delamare.**—On the influence of the chemical state under which an element is presented to an organism on the rapidity of the passage of this element through the blood, by M. A. **Mouneyrat.**—On a law of decrease of effort as given by the ergograph, by M. Charles **Henry** and Mdlle. J. **Joteyko.**—Biot's hypothesis on the height of the atmosphere, by W. **de Fonvielle.** From the consideration of the fall of temperature as the distance from the surface of the earth is increased, there would appear to be a sharp limit to the possible height of the truly gaseous atmosphere.

Göttingen.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), No. 6 for 1902, and No. 1 for 1903, contain the following memoirs communicated to the Society:—

November 29, 1902.—C. **Jacobj**: On the pharmacological action of the cyclic isoximes.

July 26.—V. **Cuomo**: Measurements of electric dissipation in the open air at Capri (March–September).

January 24, 1903.—E. **Riecke**: Contributions to the theory of atmospheric electricity. (1) On the dissipation of electricity in enclosed spaces.

January 10.—W. **Voigt**: On the magnetic induction of regular crystals.—A. **Schœnflies**: On the proof of a fundamental theorem in the theory of point-aggregates.

February 6.—E. **Riecke**: Contributions to the theory of atmospheric electricity. (2) On the dissipation of electricity in uniformly moving air.

DIARY OF SOCIETIES.

WEDNESDAY, April 15.

Royal Microscopical Society, at 8.—On a New Method of Using the Electric Arc in Photomicrography: E. B. Stringer.—An Exhibition of Mounted Rotifers of the genus Brachionus: C. F. Rousselet.

Royal Meteorological Society, at 7.30.—The Prevalence of Gales on the Coasts of the British Islands, 1871–1900: F. J. Brodie.—The Duration of Rainfall: J. Baxendell.

THURSDAY, April 16.

Mathematical Society, at 5.30.—Exhibition of the Logo-Logarithmic Slide-rule: C. S. Jackson.—On the Deduction of Schlömilch's Series from a Fourier Series, and its Development into a Definite Integral: R. F. Gwyther.—On those Functions which are Defined by Definite Integrals with not more than Two Singularities: E. T. Whittaker.—Note on Exact Solutions of the Problem of the Bending of an Elastic Plate under Pressure: Prof. A. E. H. Love.

Linnean Society, at 8.—On some Points in Connection with the Ordinary Development of Vaucheria Resting Spores: Dr. H. Charlton Bastian, F.R.S.—The Labial and Maxillary Palpi in Diptera: W. Wesché.—On Freshwater Rhizopods and their Classification: Prof. G. S. West.

SATURDAY, April 18

Geologists' Association.—Excursion in Conjunction with the Geological Section of the Croydon Natural History Society. Directors: N. F. Robarts and W. Whitaker, F.R.S. Members meet at New Cross Station (L. B. & S. C. R., down platform), at 3.21 p.m. Object: To see the Reopening of the Cutting S. of the Station, showing the Junction of the London Clay with the Beds below.

CONTENTS.

THURSDAY, APRIL 16, 1903.

ECONOMIC VEGETABLE PRODUCTS.

Die Rohstoffe des Pflanzenreiches. By Dr. Julius Wiesner. Second Edition. Ten parts. In two volumes. Pp. xi + 795 and vi + 1070. (Leipzig: Engelmann, 1900-1903.) Price 3*l*.

THE vast importance of an accurate knowledge of the raw materials of vegetable origin must be so patent to everyone as to give rise to the thought that the number of text-books on the subject must necessarily be very large. From the vast and ever-increasing colonies of this country huge quantities of material of the most varied description, and almost incalculable value, are annually poured into its markets. Hundreds of different kinds of timbers, fibres, gums, resins, dye-stuffs, tanning materials, &c., are brought hither to be devoted to various technical uses or to be distributed to other countries. Very frequently, too, specimens of drugs and other products are sent from abroad accompanied by queries as to their quality, uses and value; such queries are generally addressed to brokers or to the sender's private friends. It is therefore evidently a matter of primary importance that these products should be investigated and classified, their uses examined into, and the means bv which their identity and purity may be established should be determined and recorded. A lexicon or handbook might thus be compiled which would be of inestimable worth to those who deal in or use such vegetable products, and might be the means of introducing valuable substances, or even of establishing new industries. It is in England of all countries where one would expect to find properly staffed institutions where such investigations would be carried out, and where men would be trained for such work; in England, unfortunately, this study is much neglected, although the conditions are more favourable than elsewhere. Museums with large collections of economic products exist, but they remain for the most part a mass of unsifted and undigested material. An effort in the right direction has, it is true, been made in the Imperial Institute, which, properly encouraged and extended, may yet yield valuable results.

It is remarkable that Austria should be the country in which the study of economic vegetable products has been most sedulously pursued. The first edition of Prof. Wiesner's "Rohstoffe des Pflanzenreiches" was published in Vienna in 1873, but since that time the field has so rapidly increased in extent that the author found it necessary, in preparing a second edition, to invite the cooperation of a number of his colleagues, each of them a specialist in his particular department. Amongst these the names of Hanausek, v. Höhnel and Vogl may be mentioned as a sufficient guarantee of the excellence of the work thus contributed. No better plan than this could have been followed; it has been adopted in other works with conspicuous success.

The subject-matter is divided into twenty-three sections, of which, perhaps, those dealing with the gums, resins, vegetable fats, starches, barks, woods and fibres are the most important, comprising, as they do, some 1135 pages out of 1822. The classification of the substances dealt with rests, therefore, upon a scientific basis, and is no doubt the best that could have been adopted, though it has the disadvantage of disregarding the uses to which the various products are put; materials that are used in any particular industry are therefore often scattered throughout the work, an inconvenience which might easily be remedied by the introduction of lists of the substances tabulated according to their uses.

The arrangement of each section may be illustrated by a short description of one of the most important, viz. the resins, which covers some 200 pages, and has been written by Profs. Wiesner and Bamberger. Commencing with a description of the characters of resin generally, the authors pass to the consideration of the physical characters of the resins, and then deal with the chemical composition of such as have been investigated. Following upon this is a long list of plants, mostly trees, from which resins have been obtained, and lastly, a detailed account of each of the more important members of the group. Considerable attention has been paid to the appearance of the interior, as well as the exterior, when examined under the microscope, the various lines, fissures and other markings that make their appearance during the drying and weathering of the resin being described. Many of these appear to be characteristic, but they are not always easy to discern.

The formation of the resins in the cells in which they are produced, and especially the pathological formation, whether intentionally or accidentally induced, is, however, briefly treated. This is somewhat a matter for surprise. Recent researches have shown that certain valuable resins and oleo-resins are pathological products the formation of which is artificially induced, and it remains to be seen whether in other cases a similar formation or increase of production cannot be brought about, a problem of great economic importance.

The chemical composition is well brought up to date, all the recent investigations of Prof. Tschirch and his pupils having been thoroughly sifted.

The sections on fibres, by Prof. Wiesner himself, and on woods, by Prof. Wilhelm, both very important subjects, are most completely and attractively dealt with. More than 100 different kinds of timber are described, and many are illustrated by woodcuts of their transverse sections. In both of these sections the hand-lens and the microscope play, as may be imagined, a very important part. A useful adjunct to each of these sections would be an analytical key by which an unknown member of the class might, within certain limits, be identified.

The starches form another group that has received detailed treatment. The formation of starch, its chemical composition and the changes it undergoes when hydrolysed, are very thoroughly discussed. The groups of catechus, india-rubbers and vegetable fats have been dealt with by Prof. Mikosch, and somewhat more briefly, considering their great technical importance, than the other sections of the work.

Very conspicuous throughout both volumes is the scientific treatment that underlies the descriptions of the substances dealt with. It is this that raises the work above an ordinary handbook for merchants, and places it amongst scientific treatises. It is, in fact, a scientific treatise on the raw materials of the vegetable kingdom.

Whilst the information given is generally trustworthy, it must be admitted that here and there defects occur. Thus, for instance, the commercial varieties of benzoin are scarcely in accordance with the conditions obtaining on the London market at least; African kino might have received more consideration than it does, whilst Butea kino is comparatively rare; the botanical source of patchouli leaves is open to question. But these are small matters, and do not appreciably detract from the value of the treatise.

Prof. Wiesner and his colleagues have undoubtedly supplied a want that has long been felt. They have given to all who are interested in economic products a ready means of obtaining scientific as well as technical information concerning them. Such a work cannot but prove indispensable to many busy men, and as such it can be confidently recommended.

Henry G. Greenish.

DISEASES OF THE RESPIRATORY AND CIRCULATORY ORGANS.

A Manual of Medicine. Edited by W. H. Allchin, M.D., F.R.C.P., Lond. Vol. iv. Diseases of the Respiratory and Circulatory Systems. Pp. xi+493; illustrations, charts, coloured plates and tables. (London: Macmillan and Co., Ltd., 1902.) Price 7*s.* 6*d.* net.

Diseases of the Organs of Respiration. By Samuel West, M.A., M.D., F.R.C.P. In two volumes. Pp. xix+913; with numerous diagrams and illustrations. (London: C. Griffin and Co., Ltd., 1902.) Price 1*l.* 10*s.* net.

THE first book before us is the fourth volume of Dr. Allchin's "Manual of Medicine," and deals with the diseases of the circulatory and respiratory organs; as in the other volumes of this manual different sections are dealt with by different writers. It may be said at once that volume iv. is quite up to the high standard already attained by its predecessors, and while being less cumbrous and involved than the larger manuals or systems of medicine, contains all that can, in ordinary circumstances, be required by either the advanced student or the practitioner of medicine; as in the preceding volumes bibliographies have been suppressed, and references to authors are few and far between. The book suffers, perhaps, from being too condensed, but it is difficult to see how this, without restricting its sphere of usefulness, was to be avoided.

In the present review it would be impossible to give any detailed account of the essays which compose the volume. They are written by authors of reputation in the subject of which they write, and bear sometimes more, sometimes less marked evidence of individuality. Two essays by Mr. Leonard Hill, one on the general anatomy and physiology of the respiratory system and one on that of the circulatory system, open the respective sections of the book. These articles are very condensed but very comprehensive, and occupy approximately one-tenth of the volume. The advisability of including such articles in a book of this kind may be open to question; if they are included, however, it is certainly well that they should be complete.

Approximately 300 pages are devoted to the diseases of the respiratory organs; more than 200 of these are written by Dr. Hector Mackenzie; in this connection we would draw especial attention to a section on the general symptomatology of diseases of the lower respiratory tract, which is lucidly written and well classified.

Practically the whole of the section devoted to diseases of the circulation is written by Dr. Mitchell Bruce. The author devotes considerable space to the physical examination of the heart and vessels, and to the general symptomatology of cardio-vascular disease. The section devoted to the course and prognosis of heart disease is one of the most valuable in the book, the subject being treated in a very able manner. The public are far too prone to regard morbus cordis from the point of view of prognosis as an entity; the section before us shows how utterly unjustifiable this generalisation is, and how the whole key to the question of prognosis in heart disease depends upon the way in which the patient's cardio-vascular system reacts to the cardiac lesion, and the life which he is prepared to lead. The treatment of heart disease is fully discussed upon accurate physiological lines, but here we think the author might have entered more fully into the physical methods of treatment, such as massage, exercises, &c., and the effect of these upon the normal and pathological circulation.

The volume closes with a very interesting essay upon œdema, including under this term dropsy in its general sense. Although much in this chapter is to be found in text-books on general pathology, yet, nevertheless, the inclusion of it in the volume before us will doubtless prove of convenience to the reader.

In conclusion we may say that the volume is thoroughly to be recommended, both to the student and the practitioner, and we have little doubt it will receive at the hands of the medical profession the success it deserves.

The second work we have before us is one of quite a different character. It is a compendious treatise on diseases of the respiratory organs. Its author, Dr. West, has devoted much time and work to its compilation, and the book bears very strongly an individual stamp. Many diseases, and occasionally even different varieties of the same disease, are illustrated by the notes of clinical cases for the most part derived from the practice of the author. It is difficult with the space at our command to draw adequate attention even to special chapters.

It may be at once said that the book is not suitable for the ordinary student, and will probably find its

chief usefulness as a book of reference; and in this connection it is to be regretted that the index is not so complete as it might be. The reviewer can find, for instance, no mention of oxygen or St. Moritz in the index. The latter omission is perhaps excusable in that Davos is indexed, but the former should certainly not have been omitted. The treatment of cyanosis by oxygen is, however, mentioned in the text under acute pneumonia, and though discussed somewhat insufficiently, forms a paragraph heading. To continue with the article on pneumonia, the author draws attention to the value of bleeding in this disease, and clearly points out its indications.

In the opinion of the reviewer, one of the best written chapters in the book is the one on respiratory neuroses, including under this term asthma, whooping cough and Cheyne-Stoke's breathing, the section devoted to the latter condition being of especial interest, and containing the clinical notes of a case which presented this phenomenon continuously for eight weeks.

Under the subject of broncho-pneumonia, the author adopts an original classification for the disease, which he illustrates by cases. He brings forward evidence to show that this classification has a bacteriological justification. Some 200 pages are devoted to phthisis, and of these approximately thirty are concerned with the treatment of the disease. The subject is not treated in a specially exhaustive manner, and certain statements of the author will not meet with general acceptance. That fever rarely requires treatment in phthisis is a statement that requires modification; also it is somewhat odd that in the treatment detailed for fever by the author, no mention is made of rest in bed, although in a very short account of the open-air treatment of phthisis, obtained apparently second hand, it is distinctly stated that the patients are not permitted to take exercise if the morning temperature be above normal.

The book contains a mass of clinical fact, and the author has spared neither words nor illustrations in recording what must be regarded essentially as the result of his own clinical experiences. Judged from this standpoint, the work is interesting and valuable. As is clearly pointed out in the preface, the task was no easy one; the greater, however, will be the satisfaction of having succeeded in accomplishing it.

THE GEOLOGY OF THE ISLE OF MAN.

Memoirs of the Geological Survey, United Kingdom: The Geology of the Isle of Man. By G. W. Lamplugh, F.G.S., with Petrological Notes by Prof. W. W. Watts, M.A., F.G.S. Pp. xvi + 620. (His Majesty's Stationery Office.) Price 12*s.* net.

NOT only will this memoir, which embodies the results of a recent survey of the Isle of Man by the author, be appreciated by those who are interested in the stratigraphy of the island, but the volume will be equally welcomed by geologists generally for the valuable additions which it makes to our knowledge of dynamical and glacial geology.

The term "Skiddaw Slates," formerly applied to the rocks which form the hilly massif of Manxland, is now wisely abandoned in favour of "Manx Slate Series." Neither top nor bottom of this group is exposed, nor is its age certainly known, though Cambrian is suggested. The general structure is held to be most probably of the nature of a *synclinorium* (Dana) or *inverted fan-structure* (Heim) in opposition to the older view that it was an anticline, but the stratigraphical difficulties have not allowed this important point to be definitely established. Worm-tracks are not uncommon in some of the beds, but the author thinks that the so-called trilobite and graptolites obtained from the series are more likely to be imitative inorganic structures than true fossils.

When we read that the pebbly-looking tracts in the slates are pseudo-conglomerates, that igneous dykes simulate and have been regarded as interbedded greywackes, that truly interbedded grits have acquired an intrusive aspect and seem in some way to be connected with the metamorphism of the adjacent slates, and that earth-movements can also manufacture ripple-marks, oblique lamination, and "graptolites," it is evident that the stratigraphy has presented special difficulties, and that the surveyor has had to exercise extreme caution to avoid committing serious mistakes.

The effects of earth-movements on the Manx Slates are most interestingly described, though the principal evidence and conclusions are already familiar from Messrs. Lamplugh and Watts's paper on "The Crush-conglomerates of the Isle of Man," published in 1895. Some additional details are, however, now given. A more suitable term than "crush-conglomerate" is needed. It is liable to be confused with "crushed conglomerate," and is not sufficiently expressive of the fact that the rocks described were never true conglomerates. Another term, "autoclastic," introduced by American writers and frequently used in this memoir, might with advantage be changed to "authiclastic" (=brecciated *in situ*).

In the chapter on the Carboniferous Rocks of the Castletown area, the remarkable structures exhibited in the volcanic and associated beds, as originally described by Mr. Lamplugh in 1900, engage most attention. The details are very carefully and clearly set forth, and the conclusions, though at first startling, appear to be warranted by the evidence. The author claims that, owing to the thrusting of the Carboniferous Rocks towards the central massif of the island, interbedded lavas were broken up into blocks and displaced, and that fragments of them and of the underlying limestone were torn off and involved in the adjacent volcanic ash, thus forming an agglomerate-looking rock which is practically an uncrushed "crush-conglomerate." He suspends judgment as to the origin of the limestone "knolls" of the locality.

The author takes the view that the Peel Sandstones are of Lower Carboniferous age, whereas Prof. Boyd Dawkins asserts that they belong to Permian time. The age of these rocks is admitted to be a difficult question, but the two writers are at conflict as to facts which ought not to be in dispute. Thus, Dawkins states

that certain red rocks passed through in a boring at Knock-e-Dooney "are identical physically with those which are exposed on the shore to the north-east of Peel," while Lamplugh remarks of the same strata that "they bear no resemblance . . . . to the Peel rocks."

As would be expected from his previous glacial work the author has devoted particular attention to the glacial drifts and other superficial deposits of the isle, and in this portion of the book the writer is seen at his best. His principal conclusions are confirmatory of those of Kendall, whose work is fully acknowledged, as, indeed, is the work of all previous writers on Manx geology. He rejects the "submergence" hypothesis, and traces the sequence of events from the gradual formation of the ice-sheet through its various phases to its final disappearance. The thickness of the ice on the bed of the Irish Sea is estimated at not less than 3000 feet. The phenomena that occurred during the melting of the ice have been ably worked out, especially in the north of the island, where the formation of glacial lakes with their overflows is clearly and convincingly described.

The full details given of the metalliferous deposits should be valuable in connection with mining enterprises. The account of the igneous rocks is fairly exhaustive, the petrological descriptions being in the form of notes mainly from the pen of Prof. Watts. Considering the space devoted to the descriptions, it is a pity that the microscopic characters, especially the structures of the rocks, are not illustrated by a plate or a few text-figures.

The volume bears evidence throughout of the author's stratigraphical skill. His facts are well arranged and clearly stated, and his conclusions carry confidence to the reader's mind because there is no appearance of any attempt to make the evidence prove more than the facts will reasonably explain. C. A. M.

MEMOIRS OF PHYSICS.

Rapports présentés au Congrès international de Physique réuni a Paris en 1900. Edited by Ch. Ed. Guillaume and L. Poincaré. 4 vols. (Paris: Gauthier-Villars, 1900.)

WHEN the Société Française de Physique organised its international congress on physics, at the Paris Exhibition in 1900, it was the wish of several members of the commission appointed for that purpose, notably of their distinguished president, M. A. Cornu, whose death we have since had occasion to deplore, that a volume should be prepared which might survive the reunion which gave it origin, and form a suitable record of the same. This happy thought led to the request that a number of investigators should give accounts of their life works, showing the connections with the results obtained by previous investigations, and indicating probable advances in the future. These investigators were asked to forget, for the moment, the multitude of interesting details involved in their researches, and to treat their respective subjects from a general point of view. As a consequence, we have before us a series of memoirs on important branches of physics, each written by a recognised authority, dealing with important and far-reaching advances in physical science. The value of these memoirs is greatly enhanced by full references to original publications.

In the first volume, amongst other important papers, we may notice a paper on the precision of length determinations, by J. René Benoit. This paper contains an account of Prof. Michelson's standardisation of the metre, in terms of the wave-length of light. An interesting paper by P. Chappuis deals with practical and theoretical scales of temperature, while J. S. Ames contributes an article on the mechanical equivalent of heat, and E. H. Griffiths adds an appendix on the specific heat of water.

To the general reader, vol. ii. will perhaps be found of greatest interest. This volume deals with recent advances in optics, electricity, and magnetism; W. Wien contributes an article on the theoretical laws of radiation, which is followed by a paper on the radiation of a black body, by O. Lummer, and another on the emission of light by gases, by E. Pringsheim. These three papers form an excellent introduction to the recent extensions of thermodynamical methods to the theory of radiation. Prof. Lebedew gives an account of his experimental proof of the mechanical pressure of light, while H. Rubens describes his investigations of infra-red waves of great length. A paper by J. R. Rydberg gives a brief account of the distribution of lines in the spectra of the elements. This is a subject which will probably be greatly extended in the future; it may very probably lead to a complete mechanical theory of atomic structure, a domain into which the researches of Lorentz and Zeeman have already given us a glimpse. M. Cornu's paper on the velocity of light will be read with great interest, although it would hardly appear that the author made out a very strong case against the researches of Michelson and Newcomb. A paper on the electromagnetic theory, by J. H. Poynting, should be in the hands of all advanced students of physics. These, together with the remaining articles in vol. ii., render this of unusual interest.

Vol. iii. contains papers on recently discovered magneto-optic phenomena, by H. A. Lorentz; the theory of dispersion and metallic reflection, by P. Drude; and on radio-active substances, by H. Becquerel and by M. and Madame Curie. Prof. J. J. Thomson considers the results of recent researches on the passage of electricity through gases; V. von Lang examines the evidence as to the back E.M.F. of the electric arc, while A. Potier contributes a very readable article on polyphase currents. C. V. Boys gives an account of the various methods of determining the Newtonian constant of gravitation, with an able criticism of the various values obtained.

The fourth volume contains the minutes of the congress, a number of replies to criticisms and short communications, and, finally, a list of names of the members. E. E.

OUR BOOK SHELF.

Grundriss der qualitativen Analyse, vom Standpunkte der Lehre von den Ionen. Von Dr. Wilh. Böttger. Pp. xii + 249. (Leipzig: W. Engelmann; London: Williams and Norgate, 1902.) Price 7s. net.

This work is intended to fill in the outlines sketched with such ability a few years ago by Prof. Ostwald in his little book on analytical chemistry. In that book it was shown how the facts and operations of analysis may be viewed in the light of physicochemical doctrines in general, and of the ionic theory in particular. Dr. Böttger now supplies the detail, so that a student may make his way over the whole territory of analysis hearing and speaking only the language of the new dualism.

It is probable that a casual examination of this book will arouse feelings of exasperation in the minds of those who think that the ionic theory should be kept in a state of suspended animation, and not used until somebody (at present unknown) has either made it perfect or else has shown that it is unfit to live. To those who see in the new dualism a theory which accords in a singularly complete way with the phenomena of analysis, Dr. Böttger's book will be extremely welcome.

It is too early yet to judge of the stamp of chemist that will be produced out of students whose whole chemical discipline has been in the school of thought represented by this book, but one thing seems certain in regard to analysis, and it is that such students will be habituated more than has ever previously been the case to look behind the mere reaction and learn something of the play of forces to which it is due. This will undoubtedly be a great gain, for the bane of analysis for educational purposes has been the tendency of people to regard it more as an art than as a science.

Dr. Böttger divides the subject under the usual headings—examination of a solution for the metallic constituents in the six analytical groups, examination of a solution for the anion in five groups, complete analysis of a given substance, solution and fusion of solids, rarer elements. A set of analytical tables is contained in a pocket inside the cover.

Very full explanations are given throughout of the individual reactions and of the separation processes, and short sections are devoted to such subjects as reversible reactions, mass action, solubility-product, &c.

It is probable that Dr. Böttger's book will for some time to come rank as the standard work on analysis as considered from the point of view of the ionic theory.

A. S.

A Treatise on Roads and Pavements. By Ira Osborn Baker, C.E. Pp. viii+635; with 171 illustrations. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 5 dollars.

The object of this book, as set out in the preface, is to give a discussion from the point of view of an engineer of the principles involved in the construction of country roads and city pavements. The contents of the book relate almost entirely to American practice, where, according to the author, 95 per cent. of the mileage of the public highways consists of earth roads, a form which has almost entirely vanished from this longer established country. To the making and manufacture of earth roads the author therefore devotes a considerable part of his book; the remainder deals with roads having permanently hard surfaces used in urban and suburban districts; this part also is based on American experience, because, to use the author's words, "the principles of road making worked out in America are probably best suited to American conditions, and also because in most particulars American roads and pavements are superior to any other in the world." Yet, notwithstanding this superiority over the rest of the world, which may be open to question, the author admits that even in America there is still room for improvement.

The book is divided into twenty chapters, dealing respectively with the location, making and management of earth roads; roads covered with gravel and broken stone; horse tracks; street pavements, their design, drainage, foundations, and materials for paving, including bricks, asphalt, cobble stones, granite and other cubes, wood and tar macadam; foot-ways and bicycle tracks.

Although the estimates of cost and methods of procedure do not apply to work done in this country, there is a great deal in the book that may be read with profit by English road engineers and surveyors. The information and statistics given in the chapter on traction might be useful to the committee of the British Association that is now engaged in considering this subject.

International Catalogue of Scientific Literature. Vol. v. First Annual Issue. Astronomy, E. Pp. xiii+303. Published for the International Council by the Royal Society of London. (London: Harrison and Sons, 1902.) Price 21s.

Readers of Nature are now familiar with the method adopted in classifying the subject-matter brought together in these annual volumes, seventeen volumes of which form a complete yearly issue of the catalogue. The work before us is the first of these annual issues dealing with astronomy, and one, therefore, of special interest to astronomers, as the latter are already well supplied with the valuable volumes of the *Astronomischer Jahresbericht* (published by Walter F. Wislicenus with the support of the Astronomischen Gesellschaft), which have now reached their third year, and contain in addition a brief abstract of nearly every paper.

Comparing the two volumes from the point of view of subject classification, there are some slight variations, which, however, make no material difference. On p. 1 of the volume before us "spectroscopy" seems to be added to the list of "primary divisions" as a kind of appendix, but on further investigation this arrangement, which is a very good one, seems to have been adopted since this subject is common to more than one of the primary divisions. Before using the book, the British reader is advised to read the instructions on pages xii. and xiii., and it seems curious that these instructions are not translated into French, German, and Italian, like the other portions of general information.

It is difficult to overestimate the importance of the present publication and its value to astronomers in aiding them to follow the work carried on in other countries.

Der echte Hausschwamm und andere das Bauholz zerstörende Pilze. By Dr. R. Hertwig. Second and enlarged edition, by Dr. C. F. von Tubeuf. Pp. vii+105; illustrated. (Berlin: Springer, 1902.)

Both mycetologists and practical men will welcome the appearance of this second and revised edition of a well-known work dealing chiefly with the life-history of the fungus of dry rot (*Merulius lacrymans*) and the best modes of preventing its devastations, but likewise discussing other kinds of wood-boring funguses. In the first chapter the distribution of this fungus and the woods it chiefly attacks are discussed in detail, while in the second attention is concentrated on its mode of development, and the means by which its presence can be detected. Illustrations, one in colours, in the latter chapter show the appearance presented by

wood in an early stage of dry rot, while others depict the spores of the fungus. The life-history of Merulius forms the subject of the third chapter, in the course of which it is shown that moisture aids in its development and spread. The mode in which it affects wood, and the manner of its propagation, are discussed in subsequent chapters, after which the best methods of prevention are taken into consideration. A second and much shorter section of the work is devoted to the nature and ravages of *Polyporus vaporarius* and other wood-destroying funguses. R. L.

How to Work Arithmetic. Parts i. and ii. By Leonard Norman. Second Edition. Pp. xvi + 77 in each part. (Rugby: G. E. Over, 1902.) Price 1s. 6*d*. net each.

These small volumes contain the same series of 136 "model problems worked in full by elementary, and advanced methods" respectively. In part ii., the shorter method of long division is adopted, which makes it preferable to part i., even for beginners; and questions which are solved by the "unitary method" in part i. are solved by "proportion" in part ii. The problems are, many of them, of a somewhat old-fashioned and useless character, and while the range is fairly comprehensive, the omission of examples of methods of approximation seems remarkable. There is a misprint in the recurring decimals which are "worth knowing"; the terms "odd" and "even" instead of "alternate" in the test of divisibility by 11 are apt to be misleading. Every pupil with a good teacher ought to make a collection like this for himself, but the books should prove useful to self-taught students.

Untersuchungen über den Lichtwechsel Algols. By Ant. Pannekoek. Pp. xxiv+236. (Leyden: L. van Nifterik, 1902.)

In this volume the author has collected and discussed the chief observations of Algol that have been made since the publication of John Goodricke's results in 1783.

The observations of Plassman, Argelander, Heis, Müller, Wilsing, the author and others are included, and the various methods of obtaining and interpreting the results are analysed and compared.

The construction of comparison-star light scales, photometric measurements, the magnitudes at, and the duration of, the maxima and minima, the construction of the light curves and their asymmetry, are amongst the other subjects which are discussed in detail.

There are two appendices, the first of which deals with the corrections which have to be applied to these observations, whilst the second gives the details of the observations of Plassman, Pannekoek, Argelander and Heis respectively, in tabular form. W. E. R.

My Nature Notebook. By E. Kay Robinson. Pp. ii +211. (London: Isbister and Co., Ltd., 1903.) Price 2s. 6*d*.

During 1902, Mr. Robinson contributed weekly a series of interesting "nature notes" to the *Daily Graphic*, and the fifty-two instalments are here re-published in book form. Under each week are to be found five or six short paragraphs, describing in a chatty way certain aspects of nature noticeable at that period of the year. To the intelligent person living in the country, such a book as this should prove of great use, for under the author's guidance there will be no difficulty in knowing what and how to observe, and quite a short experience of such personal observation will develop a love for plants and animals of many kinds.

LETTERS TO THE EDITOR.

The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*]

Can Dogs Reason?

The answer to the question, "Can an animal reason?" depends upon the sense in which the word "reason" is used. If dog-stories are to be accepted as evidence, the question must be answered in the affirmative, even though the most liberal, and human, significance be attached to the word. It is, however, of great importance that data should be obtained under conditions which can be rigidly controlled, in order that the credibility of anecdotes may be tested by the results of observations which can be easily repeated. Already excellent work has been done in this field by Lloyd Morgan, Thorndike, Small, Mills, Hobhouse, and others, but the science of animal psychology is still in its infancy.

That an animal can compare a sensation newly received with memories of sensations, and form a perceptual judgment, which leads to action suitably adapted to its circumstances, no one doubts; but this is hardly reasoning in the usually accepted meaning of the term. We may, for the sake of simplicity, term the forming of a perceptual judgment putting one and one together. But can an animal compare an inference with an inference? Is it capable of what we term the syllogism, when speaking of human thought? Can it "put two and two together" within the

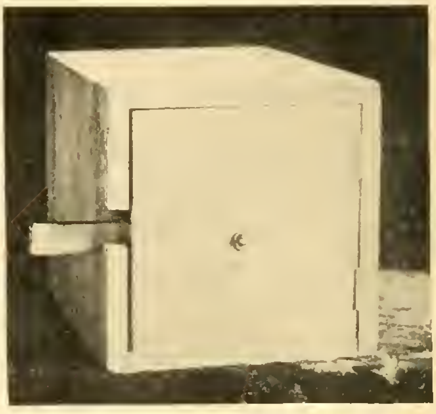


Fig. 1.

common meaning of this phrase? I am, of course, conscious of the absurdity of applying the term syllogism to the wordless thought of an animal, and also of the fact that a perceptual judgment may be expressed in syllogistic form, but my meaning will, I think, make itself sufficiently clear in the description of the following experiment:—

An exceptionally intelligent fox terrier was taught to open a box by lifting a wooden latch with its nose. Some care was spent upon the design of this box (Fig. 1). The latch was in the first instance long, and therefore easily lifted. Behind the door was placed a spiral spring, which could be twisted until it exerted any degree of pressure which seemed desirable. As the dog learnt to lift the latch, the length of the latch was curtailed. At the same time the spring was tightened until it pressed against the door with a degree of force which made the latch so stiff that the dog could not lift it without deliberate effort. There was no risk of its being opened by a chance movement. The dog was rewarded with food for performing the trick, which soon became so familiar as to be a game. As often as the door was closed the dog opened it. If he found the box on the floor he invariably opened it without waiting for any sign.

Frequently he examined the interior of the box when he had opened it, but food was never placed inside it. One evening, after the trick had been shown to a number of friends in order that the dog's almost ridiculous familiarity with it might be noted, Peter was sent to bed without his supper. He is fed but once a day. Next morning a hot grilled bone was placed in the box. The box was placed in a small yard surrounded by the house. The "boot-room" opens into the yard on one side, and into a passage on the other. After the dog had had a run in the garden the passage door into the boot-room was opened. We were watching the yard from an upper window. Two minutes after entering the boot-room Peter smelled the bone, ran through into the yard, and approached the box. When he saw the latch he ducked his head as if intending to lift it, but desisted. He then sniffed excitedly at the box and pushed it with his nose. He returned to the boot-room. After a few minutes he came out again into the yard and sniffed in the same way at the box. Twice he pushed the latch from behind, but did not put his head beneath it. After a while he returned to the boot-room and showed no signs of revisiting the box. He was then taken for a twelve-mile run in the country. As he seemed to be tired when he reached home, he was left for half an hour in the boot-room to rest. After a run in the garden, he was re-admitted to the boot-room, with the yard-door open. Unluckily the wind blew the door to before Peter had gone into the yard. After we had watched for some time my son went down to see what had happened—opened the door and pushed the dog through it, backwards. He went straight to the box, lifted the latch in the most business like way, and took out the bone.

The experiment was repeated a fortnight later with identical results. The dog ran into the yard, sniffed at the box, pushed it with his nose, was very eager to get the meat, but, this time, he showed no sign of remembering the way to open the box. He returned a second time, and then desisted altogether. During the morning the dog remained about the house. He constantly asked to be admitted into the boot-room, and showed in the clearest manner that he remembered that the grilled bone was to be found that way. At twelve o'clock the door was opened for him. He went straight through into the yard, opened the box, and took out the bone, which he attacked without any sign of doubting his legal right to its possession. It may be noticed that he is frequently fed in this yard.

In this experiment the dog knew two things. He knew how to open the box. Indeed, the sight of the latch was so strongly associated in the dog's mind with the action of lifting it that it is surprising that the usual, almost mechanical, response to sensation did not occur. Had he lifted the latch it would not necessarily have implied that he did it with the object of securing the food. He knew that the box contained meat. Eager as he was to secure the meat, he did not reason "The way to secure the meat is to lift the latch." I have described the experiment in detail, because all details are, as it appears to me, of great importance. It is to be noted that the opening of the box was associated in the dog's mind with the approbation of a human being. Great care was taken that no person should be present when the dog found the box. The sight of the box was strongly suggestive to the dog's mind of the action of opening it. With a view to diminishing the urgency of this sensori-motor association, a piece of hot meat with a strong "brown smell" was placed in the box. Its rich scent distracted his attention from the latch. When the dog was readmitted to the yard later in the morning, he was aware that the box was in the yard, and he went straight from a person to the box. By this time the bone was cold, and its scent less striking. It is impossible to repeat the experiment upon Peter, because now, when he opens the box, he invariably searches for food inside it. But I should be grateful to any of your readers who would repeat this experiment, taking great care (1) that the opening of the box is not associated in the dog's mind with finding food inside it, and (2) that, when the dog finds the box containing food, he is quite alone. I need hardly add that I shall be still more grateful to anyone who will suggest to me another test of the same kind. Alex. Hill.

Downing College Lodge, Cambridge.

Spherical Aberration of the Eye.

An account of the recognised methods of investigating the spherical aberration of the eye is given by Tscherning, "Rapports presentés au Congrès international de Physique réuni à Paris en 1900," tome iii., pp. 551–557. These methods for the most part require special experimental appliances, and for some to succeed it is necessary to resort to cocaine or homatropine injections in order to increase the size of the pupil. The following method, which requires no special apparatus or preparation, appears to have escaped observation, and may therefore be worth describing. Place a piece of white paper, on which a broad black band has been ruled horizontally, just beyond the shortest distance of distinct vision from the eye, and while looking at the upper edge of the black band, cover the pupil progressively from below by means of a card with its upper edge horizontal, placed as near as possible to the eye. At the moment when the pupil is all but completely covered, the edge of the black band will be seen to suffer a depression, its original position being regained on uncovering the pupil. On raising and lowering the card at a rate of once or twice a second, this displacement is very marked. The best success is obtained in a fairly dim light, when the pupil is expanded; care must be taken to keep the eye carefully focused on the edge of the black band, or an exaggerated displacement, due to relaxation of the accommodation of the eye, may result. The above experiment shows that, when accommodated for near vision, the optical system of the eye is over-corrected for spherical aberration, the rays transmitted near the edge of the pupil being insufficiently deviated. To prove this, let us suppose the edge of the black band to be situated on a continuation of the optic axis of the eye. Then, provided the accommodation of the eye is correct, the rays traversing the middle of the pupil will form an image of the edge of the black band at that point of the retina which is cut by the optic axis. If the rays transmitted through the upper peripheral portion of the pupil are insufficiently deviated, they will cut the retina at a point above the true image, and owing to the mental inversion of retinal images, an image apparently below the true image will be observed. On covering up the pupil from below, the true image is obscured, and that formed by the rays traversing the upper edge of the pupil is alone seen.

On repeating the above experiment, when the eye is fixed on a distant object, the image of the latter will apparently rise, showing that it really sinks, as the pupil is covered from below. This proves that, when at rest, the optical system of the eye is under-corrected for spherical aberration, thus resembling an ordinary lens.

If an image of a gas flame is formed on a white card by means of a lens of three or four inches focus, the depression of the image on the card, as the lens is progressively covered from below, can easily be observed. Edwin Edser.

April 2.

The Name Solenopsis.

It appears from your issue of March 19 (p. 480) that Dr. Wheelton Hind was to read a paper before the Geological Society on March 25, on a new species of Solenopsis. We have here an illustration of the extraordinary persistence of an untenable name. The name Solenopsis was bestowed by Westwood in 1841 (*An. Mag. Nat. Hist.*, vi. p. 86) on a very common and well-known genus of ants. In 1844 McCoy gave the same name to the genus treated of by Dr. Hind, which consists of Mollusca occurring fossil in the Carboniferous rocks. This Molluscan genus (which was made the type of a family Solenopsidæ by Neumayr) cannot possibly retain the name it bears, and it may be called Solenomorpha.

I observe that recently Reiffen has proposed the name Ludwigia for a genus of echinoderms. The same name was bestowed by Pic in 1893 on a group of beetles. More strange is Distant's recent proposal of Melania for a genus of Coreid bugs, this being the name of one of the best-known of Molluscan genera!

T. D. A. Cockerell.

E. Las Vegas, N.M., U.S.A., April 2.

The Thermal Energy of Radium Salts.

It is well known that when ordinary chlorine gas is exposed to sunlight its temperature rises above that of the surrounding medium. The rise of temperature is proportional to the intensity of the light. A certain maximum temperature is finally attained at which the rate of cooling is proportional to the rate of conversion of actinic into thermal energy. If the light stimulus be removed, the temperature of the chlorine takes about half an hour to return to that of its surroundings.

I have just read the interesting paper by MM. P. Curie and A. Laborde in the *Electrician* for April 3 (my only source of information at present), and it is reasonable to suppose that the increased temperature of radium salts there recorded might be traced to the same source. The effect with radium salts would be more persistent than with chlorine gas. But this matter can only be decided experimentally by those possessing specimens of the salts of this remarkable compound. J. W. Mellor.

London Villa, Newcastle, Staffs, April 9.

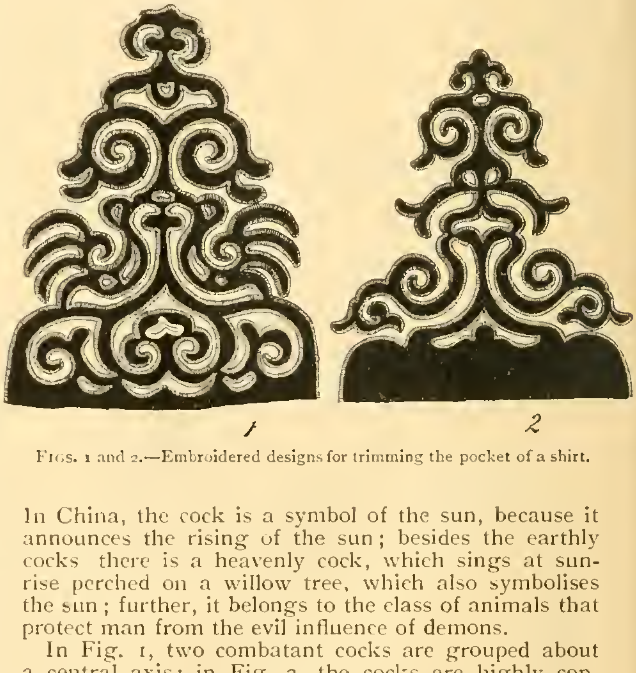
EAST SIBERIAN DECORATIVE ART.[1]

Although of late years the investigation of the decorative art of primitive peoples has received considerable attention, yet the interest taken in the subject is not so great as its importance merits. There are two methods of study, (1) the collation of specimens which happen to be in museums, with armchair deductions from the material examined; and (2) investigations in the field. When we recall the errors into which the former method has landed students, we must endorse the following remarks made by Mr. Laufer:—"I must confess," he says, "I adhere to the principle that ornaments should not be regarded as enigmas which can be easily puzzled out by the homely fireside. Neither are ornaments of primitive tribes like inscriptions, that may be deciphered; they are rather productions of their art, which can receive proper explanation only from the lips of their creators." Mr. Laufer speaks from experience, as he spent two years among the various tribes of Saghalin Island and the Amur region, and one result of his painstaking investigations is an exhaustive memoir on the decorative art of the Amur Tribes, which has recently been published in the *Memoirs* of the American Museum of Natural History. The researches were undertaken under the auspices of the Jesup North Pacific Expedition, and they have been published with that wealth of excellent illustration to which our American colleagues have accustomed us.

Among the Amur tribes plastic art is practically unrepresented, except among the Gilyak, but they excel in the decoration of surfaces. The Gold are well versed in all branches of this latter art, especially in embroidery, while the Tungusian tribes of the Amgun and Ussuri Rivers are unsurpassed in cutting ornaments for decorating birch-bark baskets. The farther to the east the more destitute is the art, but it attains its climax where it is in direct contact with Chinese influence. It is extremely probable that the decorative art of these Tungusian tribes was primitively very poor in quality, but from very early times they adopted Chinese devices and, very likely, further developed them independently. It is, however, surprising that exactly corresponding devices have never been found in China, nor adequate explanations obtained for related ones, the explanation being that traditions regarding the meaning of certain patterns are fuller, and have been better preserved in the minds of the unlettered tribes than in the fleeting memory of a writing nation; but, after all, we know very little about the significance of Chinese decorative art. On the whole, we may regard the decorative art of the Amur tribes as an independent branch of East Asiatic art which sprang from the Sino-Japanese cultural centre.

The materials used by the Amur tribes for decorative purposes are wood, birch-bark, fish-skin, elk and reindeer skin, cotton and silk. The general style of the decorative art can be gathered from the accompanying illustrations. The Gilyak used to carve spoons for domestic use; these are now replaced by spoons of Russian make, but carved spoons are still employed for the bear-festival, the decoration of which has special reference to the festival; all are provided with an interlaced band ornament, which represents the ropes with which the living bear is bound.

There are many patterns and devices which appear to be simple or grouped spirals, sometimes associated with bands and circles, but in the vast majority of the designs Mr. Laufer has demonstrated that the cock and the fish play a very important part; the former is more frequently reproduced than all other animals together. The cock is not indigenous, but was first introduced by the Chinese, nor does it enter into the mythology of the natives as it does with the Chinese.



Figs. 1 and 2.—Embroidered designs for trimming the pocket of a shirt.

In China, the cock is a symbol of the sun, because it announces the rising of the sun; besides the earthly cocks there is a heavenly cock, which sings at sunrise perched on a willow tree, which also symbolises the sun; further, it belongs to the class of animals that protect man from the evil influence of demons.

In Fig. 1, two combatant cocks are grouped about a central axis; in Fig. 2, the cocks are highly conventionalised, their tails being in the form of an ornamental double fish-tail. The bifurcated arms projecting on either side above the cocks are meant for fishes, which are essentially characterised by the form of the tail. In the large triangle to the left in Fig. 3 we have two musk deer, which is the animal most frequently represented after the cock and fish, but their bodies are implicated in cock and fish motives. The other large triangle should be looked at upside down; there is an oval object between the two cocks' beaks in the centre; above the beaks are the cocks' combs, and below are two easily recognised fishes. The smaller triangles contain a medley of bird and fish motives. In Fig. 4 a fish is represented at *a*, above its head is a beak-like figure *c*, and two curves *b*, which are probably the tail feathers of a cock; *d* is a spirally-

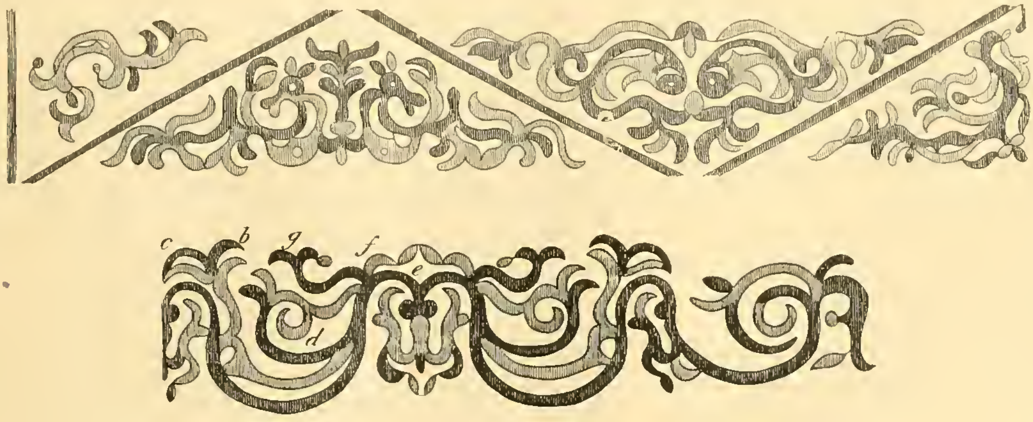
[1] "The Decorative Art of the Amur Tribes." By Berthold Laufer. The Jesup North Pacific Expedition: *Memoirs* of the American Museum of Natural History. Vol. vii. (Anthropology, vol. vi.) Pp. 86, 33 plates containing 230 figures, and 24 figures in the text. (New York, 1902.)

formed fish which passes into a beak at *e*; but this fish forms the body of a cock (there is also a fish in the body of each cock in Fig. 1); *f* is its beak with an oval in front of it, behind it is an eye which touches the crest, or cockscomb, which itself terminates in a fish's tail *g*. Between this and the corresponding figure are two degenerate cocks rampant, their feet are united, the long falciform beaks directed upward and the tails downward, the latter being connected by a pair of small ellipsoids. Decorated fish-skin garments, worn only by women, illustrate nearly all the forms of cock and fish ornaments, and numerous hybrids besides. The body of a cock is often shaped like a fish, and frequently has another fish enclosed within it; there are also numerous, rather complicated, ornamental arrangements, which are built up of spirals, trigrams, leaves, conventionalised fishes, and elements of the cock ornaments. Those who take the trouble to study Mr. Laufer's memoir with the care it deserves will satisfy themselves that the figures will bear these interpretations, which, after all, it must be remembered, are the explanations that the natives gave to him.

According to our author, no other explanation of the predominance of the cock and fish in the decorative art of the Amur tribes can be found than that these particular animals have an extremely ornamental character because of the great permutations of their graceful motions, and they thus lend themselves admirably to the spirit which strives after beauty of form. There is no chronological sequence in the stages of development; the single phases of development are merely various forms of different kinds of adaptation to certain spaces or to given geometrical forms, mostly spiral. The spiral, in his opinion, is not the final result of the gradual conventionalisation of realistic images, but is employed for the symbolic expression of the most varied things, since its forms are so convenient for this particular purpose. The same applies to the triskele; an entire cock is never represented by a purely geometrical triskele; the triskele plays an active *rôle* in indicating single parts of the body, but not for the whole creature. As an independent element, having a definite meaning, the triskele never occurs.

Mr. Laufer insists it should not be imagined that the representations of animal life continued to lose more and more of their original forms, and gradually shrunk into geometrical devices. On the contrary, the multifarious kinds of conventionalisation have their final cause, last but not least, in a faithful observation of nature, especially in that ability to watch motions which is so highly developed in the East Asiatic mind. The conception of a fish in the form of a spiral is based, he contends, on a true observation of that animal in its natural state; it would never have been drawn in spiral form, never have clung to a spiral, without a foundation of fact. This very capacity of the fish for motion, together with the highly cultivated power of the people to observe its motions, formed the reason for its adoption in ornamentation. The same remark holds good for the cock. It is doubtful whether this view of the author's will appeal to all of his readers; the idea that the bulk of the ornamentation of a group of people is based mainly upon conceptions of motion is certainly new. Whatever diversity of opinion there may be on minor points, there can be none as to the value and excellence of Mr. Laufer's work. It is no exaggeration to say that this is the most minute and thorough study we possess of the decorative art of an uncivilised people.

Alfred C. Haddon.



Figs. 3 and 4.—Decoration in red and light green on the rim of the cover of a lacquered tobacco box.

FLORA OF THE GALAPAGOS ISLANDS.[1]

It is now more than half a century since Sir Joseph Hooker published his famous essay on the flora of this archipelago, founded mainly on the collections made by Charles Darwin. Since then, until within the last decade, little had been done towards a more complete investigation of this highly interesting flora and fauna. It is to various American expeditions that we are indebted for a more complete knowledge. The late Dr. G. Baur was foremost in this work, and his collections and theories were briefly discussed in Nature (lii., 1895, p. 623). Baur boldly promulgated the theory of subsidence, in opposition to upheaval, in accounting for the origin of the islands, basing it upon biological evidence. Dr. Robinson, the author of the essay under consideration, and Mr. J. M. Greenman, his collaborator, in working out Baur's botanical collections were almost converted to Baur's theory. In the present work Dr. Robinson practically recants, and attempts to demonstrate that the composition of the flora favours the assumption that it is derived rather than original. I will first give some particulars of the general composition of the flora, limiting them, however, to the vascular plants.

Unfortunately for purposes of comparison, Robinson's enumeration and tabulation of the plants include all that were found growing in the islands, amongst them *Brassica campestris, B. Sinapistrum, Raphanus*

[1] "Flora of the Galapagos Islands." By B. L. Robinson. *Proceedings* of the American Academy of Arts and Sciences, xxxviii. (1902). Pp. 77-270 with three plates.

sativus, and a number of others which might have been eliminated as certainly introduced, and placed in a separate list. As it is, without considerable labour, one can only distinguish two elements, namely, the endemic and the non-endemic, the latter comprising both indigenous and certainly introduced species. It is further complicated by the fact that "undetermined species," "varieties," and "forms" are all tabulated equally, and the percentages of the constituents of the flora are calculated from mixed totals.

For instance, the percentage of endemic species of flowering plants is obtained from a total which includes fifty "undetermined species," some of which, one would suppose, are also endemic. On the other hand, fifteen "varieties" and nineteen "forms" are included in the calculation, by which the endemic element is made out to be 44·4 per cent. This Dr. Robinson designates an "extraordinary endemic element"; but, as compared with some other islands and continental areas, it is low. In the Hawaiian Islands it has been placed at 81·4, in Juan Fernandez at 68·6, in St. Helena at 61·3, in West Australia at 85, and in Central America, including Mexico, at 70 per cent. This is the specific endemic element. According to the now generally accepted generic limits, there is almost no generic peculiarity in the flora of the Galapagos. Scalesia (Compositæ), which is as well defined as many other genera of this order, is confined to the archipelago, where it is represented by seventeen described species, most of them inhabiting only one island. This peculiarity, specially characteristic of the Galapagos flora, is shared by several other leading genera, amongst them Castela, Euphorbia, Croton, Acalypha, Opuntia and Borreria. On the other hand, there are some species peculiar to the archipelago but represented in nearly all the islands. *Telanthera echinocephala* (Amarantaceæ), *Oxalis Cornelli*, *Maytenus obovata* (Celastraceæ), and *Cordia lutea* (Boraginaceæ) are conspicuous examples.

But I must not attempt to summarise the whole of Dr. Robinson's work. Briefly, he enumerates 500 named species of vascular plants, of which fifty-two are ferns, only three of which are confined to the islands. The 205 endemic species of vascular plants include members of thirty-nine natural orders. The orders most numerously represented by endemic species are Compositæ, 39; Amarantaceæ, 29; Euphorbiaceæ, 25, besides 7 endemic varieties and 7 endemic forms; Rubiaceæ, 16; Gramineæ, 13; and Boraginaceæ, 14, giving a total of 136, or two-thirds of the whole, contributed by six orders. Against this there are seventeen other orders, limited to one endemic species each. But the Cactaceæ, the species of which are still badly defined, are much more prominent and generally dispersed than some of those much more numerous in species. Members of the Cactaceæ are recorded from all of the islands except Gardner, but including the small and remote Tower, Wenman, and Culpepper Islands. The Leguminosæ, counting only six endemic species, are also very prominent in the arboreous element, from the presence of the genera Acacia, Cassia, Mimosa and Parkinsonia. *Astragalus Edmonstonei* is a noteworthy outlier of this genus, not found by any recent collector. The presence of four species of the Loranthaceæ is another interesting fact.

The affinities of the flora of the Galapagos Islands are wholly American, for the very few exceptional species may be accidental introductions. In composition it differs from that of the smaller flora of Juan Fernandez in having almost no generic endemic element, and in the specific endemic element being furnished by relatively numerous natural orders. From the flora of the Hawaiian Islands it also differs in being much less highly specialised. There are no tree-ferns, no gymnosperms, and, with the exception of grasses and sedges, of which there are 52 and 25 species respectively, monocotyledons are very poorly represented. There is one orchid, *Epidendrum spicatum*, one bromeliad, *Tillandsia insularis*, and *Commelina nudiflora*, a very widely dispersed weed in warm regions, and *Hypoxis decumbens* complete the petaloid series. The aquatic genera Potamogeton, Ruppia, Naias, and Lemna rest on single records of American collectors.

Dr. Robinson concludes his essay with an examination of the "botanical evidence regarding the origin of the Galapagos Islands." After a brief examination of the evidence in favour of the opposed theories of submergence and emergence, he says:—"During a re-examination of the whole vascular flora of the islands, I have sought further light upon this question, and now find the peculiar distribution of the plants less difficult to account for on the emergence theory than it seemed when the Baur plants were studied some years ago." I should like to discuss this "new light" briefly in a separate communication, and will merely remark here that all the proved means of dispersal of the seeds of plants to long distances are insufficient, to my mind, to account for certain insular floras generally regarded as derived rather than as residues.

W. Botting Hemsley.

A NEW NATURAL HISTORY.[1]

The increased interest in zoology certainly existing at the present time is one of the causes which has induced Prof. Davis to attempt a natural history written on lines totally different from those usually followed in works of this kind. In place of treating the various animal groups in more or less full detail according to their presumed relationship to one another, it is proposed to consider them in relation to their environment, and to lay special stress on the interdependence of animals and plants, and the bearing upon life of chemical and physical conditions. Such a mode of treatment undoubtedly has great possibilities before it, and is one which should do good by drawing attention to our lack of knowledge as to the reason of many of the structural peculiarities of animals. It is, indeed, one of the reproaches that may be legitimately brought against our present methods of zoological study that we attach far too much importance to describing and recording minute differences between closely allied animals to the utter neglect of the study of their life-history. Whether the author will be successful in this mode of treatment we cannot at present even conjecture, for the two sections of the work now before us are devoted to a brief systematic survey of the leading groups of the animal kingdom, which must form a necessary introduction to its proper subject. These two sections may, indeed, be regarded as a kind of "index-museum" to the rest of the work. They are important as serving to show that from no point of view can systematic zoology be neglected, and also that the issue of a work like the present in no wise renders the older type of natural history superfluous. There is ample room for both, and neither poaches on the preserves of its fellow.

As a whole, the author's treatment of the systematic part of his subject may be regarded as fairly successful, and the volume before us is rendered highly attractive to the general reader by the beauty of its coloured plates and other illustrations. Where all are excellent it is difficult to select any for special commendation,

[1] "The Natural History of Animals; the Animal Life of the World in its various Aspects and Relations." By J. R. A. Davis. Half-vols. i. and ii. Pp. xxxii+429; illustrated. (London: Gresham Publishing Co., 1903.)

and we take as a sample, selected almost at random, the accompanying cut of Sahara foxes, or fennecs.

In regard to classification, so far as vertebrates at any rate are concerned, the author follows in the main some of the older schemes, especially in the case of birds, and in this, we think, he is well advised. We cannot, however, agree with him in making a special "order" for the lemurs, especially in view of the recent investigations of Dr. Forsyth Major and Prof. Elliot Smith. We are, moreover, somewhat surprised to find no mention of the okapi under the heading Giraffidæ, and the statement that the giraffe is the sole living representative of that family. Naturalists will be still more surprised to find the African Anomalurus classed as a member of the squirrel family, and no mention made of the fact that it has a relative unprovided with a flying-membrane. Again, it is quite against modern usage to place the American mice and rats in the same genus (Cricetus) as the hamster. Neither is it correct to call the Indian elephant *Euelephas*, while the statement (p. 108) that the hippopotamus has only two upper incisors is inaccurate.

Fig. 1.—Sahara Foxes. (From "The Natural History of Animals.")

Although we by no means agree in many instances with the author's practice in regard to nomenclature, yet this is to so great an extent a matter of opinion that we forbear criticism. There can, however, be no excuse for describing the Indian rhinoceros in the text (p. 106) as *Rhinoceros unicornis*, and in the plate and its accompanying note as *R. indicus*, or for styling (p. 122) the llama *Lama lama* in the text and *Auchenia lama* in the plate and its explanation. *Lamaguan acus* for the guanaco, in place of *Lama guanacus*, must be credited, we presume, to the printer's "devil." The want of an index is a serious drawback to a volume which in most respects is full of interest. R. L.

NOTES.

It is now more than a quarter of a century ago that the Duke of Devonshire's Royal Commission on Science, among its many important recommendations, few of which have been taken advantage of either by the then or subsequent Governments, urged the importance of the creation of a body of scientific advice which should bring all departments in close touch with the progress of science. We warmly congratulate Lord Curzon upon the steps he has recently taken to extend the many benefits of such a body to the Indian Empire. We reprint elsewhere the text of a resolution of the Indian Government which has recently appeared in the *Gazette*, and we may hope that in a few more decades the matter may be considered by the Government of Great Britain, in which certainly such a council is as much required as in India.

The Prince Auguste D'Arenberg, Mr. Chamberlain, and Sir Archibald Geikie, F.R.S., have been elected honorary members of the Institution of Civil Engineers.

A Lahore correspondent of the *Pioneer Mail* states that the Kanwar Sahib of Patiala has made a free gift of his house at Kasauli to the Pasteur Institute at that place, with the object of its being devoted to the purposes of that institution.

The *Times* correspondent at Rome reports that the King and Queen of Italy were present on April 13 at the inaugural meeting of the International Congress of Agriculture. The congress, which is attended by representatives from many countries, will sit in Rome until April 18, when it will start on a tour of three weeks through Italy and Sicily.

Reuter reports that an eruption of the volcano Del Tierra Firme (Colombia), near Galera de Zamba, occurred on March 22 by which the village of Tiojo was destroyed. Brightly illuminated clouds, giving rise to the appearance of flames, were seen above the volcano on the night of March 24 by ships passing sixty miles off the coast.

Sir W. T. Thiselton-Dyer, K.C.M.G., has sent us a copy of a letter from Mr. H. Powell, the curator of the Botanic Station at St. Vincent, to Dr. D. Morris, the Imperial Commissioner of Agriculture for the West Indies, as an official report upon the eruption of the Soufrière on March 22; he has also sent a cutting from the *Barbados Advocate* of March 28 describing some of the phenomena of the eruption. Mr. Powell reports that the clouds of stones, ashes, &c., were of stupendous size, and rose to enormous heights, similar to those of May 7, 1902. The noise on March 22 was, however, far less than on May 7, and the electric display was very little. At 11.30 a.m., and again at 12.30 p.m., on March 21 last, huge volumes of vapour were seen ascending from the crater, and at about 6.30 next morning the serious eruption commenced, and continued during the morning and most of the afternoon.

At 9 a.m. on March 23 there was another huge outburst. On March 22 a slight layer of dust fell at the Botanic Station, and the northern half of the heavens was shrouded in gloom, but there was no real darkness. At Georgetown a layer of ejecta about three inches deep, with stones the size of the fist, is reported, and at Tourama a layer of five inches. An estimate of the large quantities of dust which fell in the neighbourhood of the volcano can be formed from the fact, reported in the *Barbados Advocate*, that the Commissioners of Health for St. Michael at their meeting on March 23 agreed to pay 20*l*. for the removal from the streets and public ways of the volcanic dust which fell during the previous day. The dust on this occasion was very coarse, dark, and heavy, resembling that of May last rather than the impalpable grey dust of October.

From a note in a recent number of the *West Indian Bulletin*, it is satisfactory to learn that the planters of Dominica appreciate the assistance given them by the Imperial Department of Agriculture for the West Indies. An illustration of the useful work being done by this Department is afforded by a report on the soils of Dominica, which has just been issued by the Commissioner of Agriculture for the West Indies. The report gives the physical and chemical composition of twenty-three typical soils examined in the Government chemical laboratory of the Leeward Islands, and is the work of Mr. F. Watts, Government chemist. Samples were taken in all parts of the island, and the analyses published give the composition of both virgin and cultivated soils. In general, the soils of Dominica were found to be well furnished with available compounds of nitrogen and potash, but were almost uniformly deficient in phosphates, and in many cases also in lime. A microscopic examination of the soil minerals showed that they were much the same in all parts of the island, and further that they closely resembled the minerals found in the volcanic dust of the Mont Pelée eruptions. Mr. Watts concludes that "the recent volcanic activity is similar in character to that of the past."

On Tuesday next, April 21, Prof. Allan Macfadyen will deliver the first of three lectures at the Royal Institution on the blood and some of its problems; on Thursday, April 23, Prof. Dewar commences a course of two lectures on hydrogen, gaseous, liquid and solid; and on Saturday, April 25, Prof. Langton Douglas begins a course of two lectures on the early art of Siena. The Friday evening meetings will be resumed on April 24, when the Hon. R. J. Strutt delivers a discourse on some recent investigations in electric conduction. The discourse on May 1 will be delivered by Prof. W. J. Pope on recent advances in stereochemistry.

The first Easter vacation party of workers at the new Biological Station, Port Erin, is a large one, including two students from Oxford, four from Owens College, two from Liverpool, one from Leeds, and also Mr. Isaac Thompson, Mr. J. Lomas, Prof. Gregg Wilson, Mr. Chadwick, and Prof. Herdman. A small class of school teachers from the Isle of Man has also been formed for "nature-study," and is being conducted in the junior laboratory and in the field by Mr. Chadwick and Prof. Herdman. The season is a late one, both in fish-spawning and in the general condition of the fauna, but, notwithstanding the unsettled weather, a good deal of collecting and field work has been carried on.

Reuter's agent at St. Petersburg reports that Captain Kozloff lectured there on April 6 on his scientific expedition to Central Asia and Tibet, lasting from 1899 to 1901. As a result of the expedition, the central steppe of the Gobi desert and the country of Han-su and Tsaidam were traversed. Numerous meteorological observations were made, as well as a great many notes with regard to the flora and fauna of the country. After establishing a meteorological station in the Tsaidam, where the collections were left, the party started for the heights of Tibet. Captain Kozloff's expedition was at first allowed to enter the territory of the Dalai-Lama, but it was stopped on reaching districts strictly reserved. It was consequently compelled to winter for five months in the Mekong Valley. The expedition traversed and made a study of parts of Tibet which had never before been visited by Europeans, and made collections which will have an important bearing on the study of the ethnography and the flora and fauna of that country.

As already announced, the annual meeting of the Iron and Steel Institute will be held on May 7 and 8. At the opening meeting the council will present the report for the year 1902, and the president-elect, Mr. Andrew Carnegie, will deliver an address. The Bessemer gold medal for 1903 will be presented to Sir James Kitson, Bart., past-president, and the awards of the Andrew Carnegie gold medal and research scholarships for 1903 will be announced. Among the papers to be read and discussed are the following:—the alleged diffusion of silicon into iron, Mr. J. E. Stead; the influence of sulphur and manganese on steel, Prof. J. O. Arnold and Mr. G. B. Waterhouse; the open-hearth process, Lieut.-Colonel L. Cubillo; the application of electric furnaces in metallurgy, Mr. Albert Keller; the manufacture of Portland cement from blast-furnace slag, Mr. C. von Schwarz; and the effect of flue dust upon the thermal efficiency of hot blast stoves, Mr. B. H. Thwaite. Reports on research work carried out during the past year will be submitted by Messrs. O. Boudouard (Paris), W. Campbell (New York), A. Campion (Coopers Hill), P. Longmuir (Sheffield), E. Schott (Berlin), and F. H. Wigham (Wakefield), the Andrew Carnegie research scholars of 1902. The autumn meeting will be held at Barrow-in-Furness during the first week in September. An influential reception committee has been formed with His Grace the Duke of Devonshire, K.G., as chairman.

The Easter holidays have been to a considerable extent marred by the inclement weather which has been experienced generally in the British Islands. The *Daily Weather Report* issued by the Meteorological Office on Saturday last, April 11, showed that a disturbance lay to the north of Scotland and was likely to be followed by further unsettled weather. Very cold winds, chiefly northwesterly, spread over the whole country and caused frequent sharp showers of snow and hail, with very low day temperatures on Sunday and following days, the readings on the ground at night being eight or more degrees below freezing. Much damage has been done to fruit trees in blossom, and in some cases small seeds have been blown from the fields. Bright intervals of sunshine followed the squalls, and, in places sheltered from the coldness of the winds, were very agreeable. The advance of a cyclonic disturbance from the Atlantic during Tuesday has occasioned a change of wind and milder weather.

We have received the first part of vol. xvi. of *Mittheilungen* relating to German Protectorates. This valuable publication is so well known that it is unnecessary to say that it contains a large amount of useful information both for travellers and men of science. We wish particularly to draw attention to the care and thoroughness with which the German officials establish meteorological stations and collate and publish useful data for districts which would

be otherwise meteorologically unknown. The volume in question contains full results of rainfall or other statistics at no less than forty-two stations in German South-West Africa, and at thirty-two stations in German East Africa. In the latter Protectorate values for several years are given, with useful particulars relating to the instruments and their exposure. The work is accompanied by a very clear map of the north-western portion of Cameroon, between Rio-del-Rey and Bali.

WE have received a catalogue of new experimental apparatus from the firm of E. Leybold, which describes a number of instruments suitable for general and special experimental and demonstration work. Amongst these may be noted a convenient form of hand regulated arc lamp, having an arrangement by which any one of six carbons can be used, apparatus for wireless telegraphy, selenium cells, and other apparatus for wireless telephony, &c. We also note that the firm includes in the list Poulsen's telegraphone, which was described in NATURE some time ago; this is, we presume, only an experimental apparatus, as we have not heard that the invention is sufficiently perfected yet for commercial purposes.

A METHOD of electrically locating ore deposits which has been devised by Messrs. L. Daft and A. Williams was demonstrated a short time back at the Telacre Mine in North Wales. The method is practically an application of wireless telegraphy by earth conduction. An induction coil which is used as transmitter has the terminals of the secondary connected to two metal stakes, which are pushed into the soil; radiating currents are thus produced which can be detected by a telephone connected to similar stakes. Normally, the telephonic disturbance is greatest in a line at right angles to, and bisecting, the line joining the transmitting electrodes, but the presence of ore disturbs the current distribution, and the amount of shifting of the point of maximum disturbance enables the position of the deposit to be determined. It is also said that the nature of the sounds can, in some cases, indicate the depth and mineral richness. The demonstration in Wales passed off very successfully, and it seems that the system, on further development, may possibly become of considerable assistance in prospecting for ore.

WE have received from Dr. Hubert Jansen, the editor of the trilingual technical dictionary which is being published by the Society of German Engineers, a batch of circulars relating to the publication. The object, as our readers are probably aware, is to bring out a thoroughly comprehensive vocabulary of technical terms in German, English, and French; mathematical, physical and chemical words are to be included, as if not now of technical importance they may become so at any time. Special effort is to be made to include all "trade" expressions used in particular industries, local dialectical terms, and even workmen's "slang" names for machines, &c., as these often pass in time into general use. In order to make the dictionary as complete as possible, collaboration is asked from technical men, institutions, or works; the publishers will supply note-books for jotting down technical expressions (with or without their foreign equivalents) to anyone who is willing to collaborate, and these will be collected some time next year, and collated by the editors. The editors also ask that circulars, price-lists, &c., may be sent to them, as these are a fruitful source of technical expressions. We would strongly urge all who have the time and opportunity to give what assistance they can, as there can be no question of the need for the dictionary, which will be more valuable the more complete it is made. A little help from a larger number of collaborators is likely to be of greater use than a greater amount of work by a few whose experience must necessarily be limited to one or two branches of technical work.

PROF. C. LE NEVE FOSTER, F.R.S., in the fourth part of his general report and statistics concerning the mines and quarries of the world in 1901, provides much information concerning the relative importance of different countries in the mining industries. For instance, the total amount of coal produced in the world amounted in 1901 to 789 million tons, of which the United States yielded rather more than one-third and the British Empire rather less than that proportion; Germany's output was almost one-fifth. The United States, the British Empire, and Germany produced six-sevenths of the world's supply. Of the total output of minerals the British Empire produces about one-third of the coal, one-ninth of the copper, half of the gold, one-eighth of the iron, one-fifth of the lead, one-seventieth of the petroleum, one-quarter of the salt, one-ninth of the silver, five-eighths of the tin, and one-fiftieth of the zinc. More than four and a half millions of persons are engaged in mining and quarrying at home and abroad, of whom, roughly speaking, one-fifth are employed in the United Kingdom and one-third in the British Empire.

THE Charnwood Forest rocks form the subject of a well-illustrated essay by Dr. F. W. Bennett (*Trans.* Leicester Lit. and Phil. Soc., January). As the author remarks, he joined the excursion of the Geologists' Association under the leadership of Prof. W. W. Watts, and he has expounded in a clear and useful way the views arrived at by that geologist in his detailed survey of the area.

IN the first annual report, for 1902, of the Rhodesian Museum, Bulawayo, it is stated that the rock and mineral collections have been fully classified and arranged, and that a geological map of Southern Rhodesia, on a scale of an inch to four miles, is being compiled. The report contains a brief sketch of the geology of the country around Bulawayo, by the curator, Mr. F. P. Mennell; also a list of Rhodesian minerals.

THE Western Australian tellurides form the subject of an essay by Mr. L. J. Spencer (*Mineralog. Mag.*, February). The author observes that since 1896, when tellurides of gold were first recognised in Western Australia, these minerals have proved of the greatest importance, and the telluride mines at Kalgoorlie, in the east Coolgardie goldfield, now yield as much gold as all the remaining goldfields in the colony. The tellurides occur as large lenticular masses and as impregnations in schistose rocks, and they are only found below a certain depth; nearer the surface, the minerals have been decomposed with the separation of native gold. At present no definite crystals of tellurides have been found, and the author suggests that cavities in the ores should be searched. He describes several tellurides, including lead telluride (altaite), which has not hitherto been recorded from Western Australia. He further brings forward evidence to show that "Kalgoorlite" and "Coolgardite" are not homogeneous minerals, but mixtures of known tellurides.

IN the *Proceedings* of the Royal Society of Victoria (vol. xv. part ii. 1903) all the subjects dealt with relate to natural history. Mr. Frederick Chapman has commenced the description of the new or little-known Victorian fossils in the National Museum at Melbourne. Mr. G. B. Pritchard continues his account of the Tertiary mollusca, and

Mr. O. A. Sayce contributes an account of the Phyllopoda of Australia, including descriptions of some new genera and species. Prof. J. W. Gregory describes under the name Heathcotian a series of phyllites and schists, with diabases, porphyrites and amphibolites, which occur along the floor of the Heathcote Valley, and form the crest of the Colbinabbin Range, about seventy miles north of Melbourne. Conflicting opinions have been expressed with regard to the age of these rocks, and even now it is uncertain whether they are Cambrian or pre-Cambrian. In Lower Ordovician times they formed an extensive land area across Central Victoria. A new genus of trilobite, Notasaphus, is described from the Lower Ordovician rocks, and evidence is given to show that Dinesus (previously described by Mr. R. Etheridge, jun.) is also a trilobite.

THE geographical distribution of fresh-water decapods forms the subject of an interesting essay by Dr. A. E. Ortmann (*Proc.* Amer. Phil. Soc., vol. xli. No. 171). He points out that any division of the earth's surface into zoogeographical regions should not be based exclusively on the present distribution of animals. The geological history must be considered, and even then it is impossible to create any scheme that covers all cases, owing largely to the difference of the means of dispersal of the various groups of animals. In most cases the instances of "abnormal" distribution have to be traced back into the geological past to be understood properly, and the introduction of "regions" in our method is only a means of tabulating the more interesting and important facts, and not the final aim of zoogeography. The author deals fully with the geographical distribution of the fresh-water decapods, and discusses the great changes in the distribution of land and water which have modified the shapes of the continental masses since Cretaceous times. His views are clearly explained and illustrated by maps showing the "regions" of past periods, and these lead up to the "regions" of recent time, which do not differ materially from those constructed by Wallace on distinct principles. The author deals not only with the causes of present distribution, but points out reasons for the local absence of particular forms—the crayfishes and crabs, for instance, being mutually exclusive.

IN the *Publications* of the Field Colombian Museum, Dr. Millspaugh has compiled a "Flora of the Island of St. Croix." Baron Eggers published a "Flora of St. Croix and the Virgin Islands" in 1879, and the present list incorporates the plants brought together by Prof. Ricksecker of Iowa, but does not include the collections made by several Danish botanists

THE characters and affinities of the oxlip form the subject of a small brochure, in which Mr. C. Bailey amplifies a paper read before the Manchester Field Club. The true oxlip, known distinctively as Jacquin's oxlip, is found only in certain of the eastern counties, grows in the uplands on Boulder-clay, and is associated more often with the cowslip than with the primrose. Crosses with the cowslip are rare, with the primrose more frequent, suggesting that its racial affinities are closer with the latter.

THE problem of unravelling the true relationships between various plant rusts has been taken up by Prof. J. C. Arthur in America, and in addition to papers published in the *Botanical Gazette*, this subject formed the theme of an address to the Botanical Society of America. By means of cultures extending over several seasons, the author has endeavoured to discover the second host plants on which many rusts complete a stage of their life-history, and also to determine the differences between apparently similar forms which develop as totally different varieties. Prof. Arthur has confined his experiments mainly to the rusts which occur upon grasses and sedges.

A THIRD edition of Engler's "Syllabus der Pflanzenfamilien" shows some additions of which the more important are the incorporation of several paragraphs summarising the principles of systematic classification, and the introduction of a list of the more definite vegetative formations of the world. In the syllabus the changes refer mainly to points of detail, as in the ultimate subdivisions of a few of the phanerogamic families, also there has been some rearrangement of the main divisions of the lower organisms. The value of the book lies, of course, in the portion dealing with the higher plants, and objections might be offered to the arrangements of several of the cryptogamic groups. Under the Dictyotales, the occurrence of motile antherozoids demonstrated five years ago by Lloyd Williams is not yet noted.

A NEW monthly journal devoted to bacteriological research, the *Bulletin de l'Institut Pasteur*, has just been commenced. It is to be conducted by the junior staff of the Pasteur Institute, and appears to be much on the lines of the *Centralblatt für Bakteriologie*. The first number issued contains an introduction by M. Duclaux, an article by M. Roux upon microorganisms that are so minute as to be invisible, and a number of reviews of articles in current periodicals.

THE Corporation of the City of London is rightly taking part in the crusade against tuberculosis. It has for many years instituted legal proceedings against farmers, butchers and meat-salesmen for sending tuberculous meat into the City markets, or for exposing the same for sale. Since it would appear that in some cases such offences may have been due to ignorance, the Public Health Department has issued a circular describing the indications of tuberculosis in the carcase, and the symptoms of the disease in the living animal, drawn up by Dr. Collingridge and by Mr. King, the Medical Officer of Health and the Veterinary Inspector respectively.

WE have received the report of the Director of the Illinois State Laboratory of Natural History for the years 1899–1900.

THE necessity for financial assistance, if its work is to be adequately carried on and expanded, is the cry of the Committee of the Marine Biological Association of the West of Scotland, of which the report for 1902 is just to hand. It has been decided to issue an appeal for an endowment fund of 25,000*l*. "The Millport Station," according to the report, "has the almost unique distinction of being a scientific institution founded and maintained entirely by private effort, and the committee would therefore address an earnest appeal to all who have hitherto shown an interest in the station to direct their attention to this object." During the past year the opportunities offered by the Association for obtaining practical instruction in dredging and marine biology have been taken advantage of by several educational bodies. Our knowledge of the fauna of the Clyde estuary has likewise been considerably increased.

IN the report of the Lancashire Sea-Fisheries Laboratory and Sea-Fish Hatchery at Piel for 1902, Prof. Herdman makes some comments on the proposal that the British Government should take a share in the international investigation of the North Sea and its products. Prof. Herdman remarks that if those who have advised the Government to take part in it will declare distinctly that they

regard the scheme as a purely scientific investigation which may throw light on fishery problems, he is prepared to endorse their recommendation, but not otherwise. In the same report Dr. J. T. Jenkins discusses the differences between the spring and autumn broods of herring, and the question whether these are the offspring of the same parent herrings (which in that case must spawn twice in the year), or whether they belong to different races of the species, one of which breeds in the spring and the other in the autumn. The question is left undecided, although it is pointed out that the alleged differences in form between the fish of the two broods are not constant.

Prof. H. F. Osborn has sent us a budget of extracts from our American contemporary, *Science*. In one of these articles it is proposed to divide reptiles into two main sections, Synapsida and Diapsida, according to the presence, primarily, of single or double temporal arches. From a second article it is satisfactory to learn that the splendid collection of Pampean vertebrate fossils acquired by the late Prof. Cope has been unpacked in the American Museum, and is in course of being worked out. Recent investigations, it is stated in a third, have led to the abandonment of the lake-basin theory of the origin of the Tertiary strata of the great plains. Attention is likewise drawn to the large series of vertebrates—inclusive of two mammals—from the Cretaceous of Canada, recently described by Mr. Lambe. Of considerable interest is the provisional identification of a fossil mammal from Japan, to which reference was made some time ago in our columns, with Desmotylus, of the later Tertiary of California.

The Saturday afternoon excursions of the London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., will commence on April 25. Among the localities to be visited this season will be Walton-on-the-Hill, Aylesbury, Harefield, Sevenoaks, Leighton, and Tunbridge Wells. Further particulars can be obtained from the hon. sec., Mr. R. Herbert Bentley, 33 Church Crescent, Muswell Hill, N.

The second edition of Prof. A. Winkelmann's "Handbuch der Physik," which originally appeared in 1896, is in course of publication by the firm of J. A. Barth, Leipzig. The new edition will be published in six volumes, dealing respectively with general physics, acoustics, heat, electricity and magnetism, and optics. Each volume will be complete in itself, and the editor, Prof. Winkelmann, has obtained the assistance of many well-known men of science in Germany for various branches of physics. The first half of the volume on electricity and magnetism, which we have received, shows that the complete work will be a more detailed treatise of physics than exists at present for English-reading students.

Prof. W. A. Tilden, F.R.S., was elected president of the Chemical Society at the annual general meeting on March 25. The retiring president, Prof. J. Emerson Reynolds, F.R.S., delivered an address, in which he directed attention to the publication of some recent reports on progress in chemical research, and urged the publication of similar digests. He urged the study of "comparative chemistry" of inorganic compounds. There were few inquiries of greater interest than those involving inorganic isomerism, which was now either completely ignored or only slightly mentioned. Polymerism, or molecular condensation, was well known to exist in many inorganic compounds, as in the oxides of nitrogen, vanadium, niobium and tantalum. Silicon showed a great analogy to carbon, and it was highly probable that some of the native silicates were benzenoid combinations of $6SiO_2$. The more familiar cases of isomerism were the nitrites and sulphites, and isomerism had also been observed in the thiosulphates and the salts of the phosphorous acids. Attention was directed to some cobalt, platinum, and molybdenum compounds which showed this peculiarity. Another analogy between carbon and inorganic compounds was the curious and interesting catalytic action, referred to by Bredig under the title of "inorganic ferments." Colloid platinum solutions acted on many substances in the same way and under similar laws as enzymes. The whole subject was little known, but it suggested that the broader study of inorganic chemistry, especially in the light of our knowledge of the "organic" division of the science, was well worthy of much greater attention than it had received of late.

The additions to the Zoological Society's Gardens during the past week include two Maholi Galagos (*Galago maholi*) from South Africa, presented by Captain Crosse; a Greenland Seal (*Phoca groenlandica*) from the Firth of Forth, presented by Mr. E. H. Bostock; two Lesser Kestrels (*Tinnunculus cenchris*), captured at sea, presented by Mr. L. Ovens; a Long-necked Chelodine (*Chelodina longicollis*), three Muricated Lizards (*Amphibolurus muricatus*), a Quoy's Lizard (*Lygosoma quoyi*) from Australia, a European Pond Tortoise (*Emys orbicularis*), European, presented by Mr. E. Hulton; a Purple-faced Monkey (*Semnopithecus cephalopterus*) from Ceylon, a White-crowned Mangabey (*Cercocebus oethiops*) from West Africa, a Fringed Gecko (*Uroplates fimbriatus*), two Green Geckos (*Phelsuma madagascariense*) from Madagascar, four Derbian Zonures (*Zonurus giganteus*), a Blessbok (*Damaliscus albifrons*) from South Africa, an Antarctic Skua (*Stercorarius antarcticus*) from the Straits of Magellan, six Amboina Box Tortoises (*Cyclemys amboinensis*), a Ceylonese Terrapin (*Nicoria trijuga*, var. *ediniana*) from India, a Raven (*Corvus corax*), European, deposited; a Mouflon (*Ovis musimon*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Nova Geminorum.—Several observations of the new star announced by Prof. Turner on March 24 are contained in No. 3858 of the *Astronomische Nachrichten*.

Prof. Deichmüller, of Bonn, has looked up some old observations of the region, made during 1856, 1857 and 1858, and cannot find therein any record of an object having the position occupied by the Nova.

Prof. Hartwig (Bamberg) compared the Nova with two neighbouring stars, viz. B.D. $+29°$ 1336 (given as magnitude 8·3) and B.D. $+30°$ 1331 (given as magnitude 8·7), on March 26, and found that it was equal to the former and about 0·1m. brighter than the latter, whilst he records its colour as "bright orange." Two heliometer measures of the Nova's position, using the stars B.D. $+29°$ 1342 and B.D. $+29°$ 1307 as reference stars, gave for 1903:—

$$\alpha = 6\text{h. } 38\text{m. } 0{\cdot}47\text{s.}, \quad \delta = +30° \ 2' \ 27''{\cdot}0$$

and

$$\alpha = 6\text{h. } 38\text{m. } 0{\cdot}46\text{s.}, \quad \delta = +30° \ 2' \ 31''{\cdot}1$$

respectively.

Prof. Hartmann and Dr. Ludendorff, using the 80 cm. Potsdam refractor with the No. 1 star-spectroscope, obtained a spectrum of the Nova, with three hours' exposure, on March 29. The star then appeared to be of about the ninth magnitude, and the spectrum on the plate is extremely faint. The hydrogen line $H\beta$ appears as a bright emission line between λ 4857 and λ 4881, and the middle of the line is shifted about 8 Angström units towards the red. In the blue part of the spectrum there are many bright lines forming a band which has its maximum intensity from λ 4604 to λ 4672. The line $H\gamma$ is also a bright line, but is so extremely faint that it was measured with difficulty; it appears to extend from λ 4343 to λ 4356, and, like $H\beta$, to

have its centre shifted 8 Å.U. towards the red. Prof. Hartmann deduces from this "shift" that the material emitting these bright line radiations is moving away from the earth with a velocity of 520 kilometres per second. The spectrum is similar to that of Nova Persei during the latter part of March, 1901, and this fact, taken with the similar decrease of magnitude, seems to prove that the object is truly a Nova.

The magnitude was estimated at Strassburg on March 27, 13h. (M.T. Strassburg) as 7·9, and at Utrecht on March 27, 11h. 20m. (M.T. Utrecht) as 8·1.

Cooperative Determinations of Velocities in the Line of Sight.—At a meeting of the Royal Astronomical Society held on March 13, Mr. Newall read a paper dealing with the results obtained at Cambridge in connection with Prof. Frost's cooperative scheme for determining the motions in the line of sight of ten selected stars.

Mr. Newall's results dealt with the stars α Arietis, α Persei, and α Boötis, and for the first named he has obtained a mean value of $-14\cdot23$ kilometres per second. The measurements of the spectrum of α Persei seem to indicate that there is something peculiar, which is not yet accounted for, in the motion of this star. Fourteen photographs give a mean velocity of $-2\cdot61$ kilometres per second with a probable error of $\pm0\cdot28$. In the case of α Boötis four of the lines, out of the seventeen which were measured, give a velocity of an entirely different order from that given by the other thirteen lines, although the lines themselves are not remarkable in other respects; two of these lines belong to the iron, one to the scandium, and one to the titanium spectrum (the *Observatory*, April).

Wolf's Rich Nebulous Region in the Constellation Lynx.—Writing to No. 3857 of the *Astronomische Nachrichten*, Dr. Isaac Roberts states that he photographed both H. iv55 and the new nebula mentioned by Prof. Max Wolf (*Astronomische Nachrichten*, 3847) on March 24, 1897, and included them amongst the regions given in his observatory report which appeared in the *Monthly Notices* for February, 1898.

Dr. Roberts's notes describe the second nebula as 45s. following and 14′·5 S. of H. iv55, and state that "it is a spiral nebula viewed edgewise, about 285″ of arc in diameter from south following to north preceding: nucleus stellar, equal to about seventeenth magnitude, faint indications of condensations."

The Period and Light-curve of δ Cephei.—In No. 3853 of the *Astronomische Nachrichten* Prof. A. A. Nijland discusses the previous observations and calculations of the period and light-curve of the interesting variable δ Cephei (Ch. 8073). He compares the maxima given by his own formula and that of Schur with the chief observations made between February, 1785, and February, 1897, and arrives at the following formula as the one giving the nearest approximation to the true period:—

$$\text{Maximum} = 1840 \text{ September 26d. 10h. 6·2m. (M.T. Bonn)} + 5\text{d. 8h. 47m. } 45\cdot005E - 0\cdot00075sE^2 - 0\cdot00000062\ E^3,$$

or, expressed in Julian Days:—

$$\text{Maximum} = \text{J.D. } 2393375\cdot421 \text{ (M.T. Bonn)} + 5\cdot366493dE - 0\cdot00075sE^2 - 0\cdot00000062\ E^3.$$

Prof. Nijland has found during the discussion of the data that a variation of the period is suggested, and he urges the desirability of obtaining further trustworthy observations.

CONSTITUTION OF A BOARD OF SCIENTIFIC ADVICE FOR THE FURTHERANCE OF SCIENTIFIC WORK IN INDIA.

SUBJOINED is the complete text of the resolution of the Government of India referring to the appointment of a Board of Scientific Advice to organise and coordinate the scientific work done in the several Departments of the Government of India.

The application of the resources of modern science to the economic and agricultural development of the country has for many years engaged the earnest attention of the Government of India. The Famine Commissioners of 1878 laid much stress on the institution of scientific inquiry and experiment designed to lead to the gradual increase of the food-supply of the country and to the greater stability of agricultural outturn. It was considered desirable, however, first to organise the Land Record system, and so to acquire a stable basis of ascertained fact, before scientific inquiry was undertaken on any considerable scale. The necessity for such investigation was again emphasised by Dr. Vöelcker, who was deputed in 1890 to advise the Indian Government on the best course to be adopted in order to effect improvements in Indian Agriculture. At the same time the experience of recent years has indicated the increasing importance of the study of the economic products of India and of its mineral-bearing tracts, with a view to the development of the industrial and economic resources of the country.

(2) The organisation and work of the Indian Agricultural and Scientific Departments prior to 1897 have been fully described in the important series of Resolutions which issued in that year, and especially in the fourth and fifth Resolutions of the series. These contain a clear exposition of the policy of the Government of India in establishing departments of scientific research to promote the industries of the country and investigate its undeveloped resources, and they describe the means adopted to give effect to that policy. They further show how undue prominence had been given in the past to pure science, to the neglect of its economic application, and they affirm the necessity of extending the economic side of inquiry, and of coordinating the labours of the different departments on the basis of a well-considered working plan.

(3) The policy laid down in these Resolutions has been steadily pursued, though its development has been retarded by an unfavourable cycle of seasons, which seriously affected the financial resources of the Government of India. To the Geological Department two practical mining experts have been added, while each year a portion of the scientific staff devote themselves to inquiries connected with the mineral resources of India. A cryptogamic botanist has been appointed, whose special duty it is to study the fungoid diseases of agricultural staples, such as rust in wheat, which causes such serious and widespread loss to the country. In Madras a botanist has been permanently entertained whose attention will be mainly devoted to economic inquiry. And of late years the attention of the officers of the Botanic Survey has been more and more directed to questions of practical importance to the country. The establishment of the Reporter on Economic Products has been strengthened, and a Curator with special qualifications as an economic chemist has been added to it and provided with a laboratory, while one agricultural chemist pursues his inquiries at Dehra Dun, and it is proposed to procure another for Madras. An entomologist has for some time past been added to the staff of the Indian Museum; a specially qualified Forest officer has been deputed for investigation of the insect pests which devastate the forests, while the Secretary of State has been asked to secure the services of a skilled entomologist in order to conduct similar inquiries in connection with the agricultural and industrial staples of India. In the Civil Veterinary Department a highly skilled bacteriologist is studying the diseases which prove so fatal to agricultural stock in India. An agricultural expert has recently been added to the Provincial staff of the United Provinces. Finally, an Inspector General of Agriculture has been appointed whose function it is to guide and correlate the agricultural inquiries carried on throughout India, whether by the Imperial or the Provincial Governments, and to act as an adviser to both in all matters pertaining to agriculture, while under him work, or will work, the agricultural chemist, the entomologist and the cryptogamic botanist.

(4) The Government of India now desire to provide, as far as possible, for that coordination of scientific inquiry which the development of the machinery of the various departments has rendered more than ever essential. The work of many of the members of the scientific staff covers fields in which experiments of a similar or cognate character are being independently conducted. Thus in chemistry we have several investigators following parallel lines of research; in economic botany there are two departments working independently of each other; in economic entomology

there have been two specialists, each charged with investigations similar in character. Finally, the appointment of an Inspector General of Agriculture adds to the staff an official with a close interest in all the branches of science which bear upon the agricultural conditions of the country.

(5) The subject has received the careful consideration of the Governor General in Council, and he has arrived at the conclusion that a central authority is needed to ensure that the work of scientific research is distributed to the best advantage, that each investigator confines his researches to the subject with which he is most capable of dealing, and that energy is not dissipated by the useless duplication of inquiries or misdirected by a lack of inter-departmental cooperation. The various departments of science are not self-contained, but closely interlinked. Agriculture needs the aid of botany, botany the assistance of geology, geology of chemistry, and an endeavour should be made to combine the different departments in a system of mutual assistance. The Governor General in Council has no wish to imply that there has been any disposition on the part of one department to hold itself aloof from another. But the institution of an authorised scheme of mutual assistance will result in a closer cooperation for the purposes of effective research than has been possible in the past.

(6) A further reason exists for the constitution of a central advisory authority. Though greater prominence has been given in recent years to the practical or economic side of inquiry, its importance is not even yet always adequately recognised. The Government of India fully realise the great value of the work effected in the past by their scientific departments, in the shape of scientific exploration and systematic work, and they recognise that such inquiries must necessarily precede any attempt towards the solution of more practical problems. But in those departments there has been a not unnatural tendency to give the claims of abstract science precedence over the more practically important demands of economic or applied science. In making these remarks, the Governor General in Council has no desire to underrate the importance of original research for purely scientific objects, or to assert that the practical application of science should be the sole aim of technical departments. It is his wish that the high reputation which has been gained by more than one branch of scientific work in India should be maintained, and that the Indian departments should retain touch with scientific progress in Europe and America. But in view of the fact that the Indian Government own the largest landed estate in the world, that the prosperity of the country is at present mainly dependent upon agriculture, that its economic and industrial resources have been very imperfectly explored, and that the funds available for scientific work are limited, the importance of practical research is preeminent, and a central authority, which can speak with knowledge upon scientific questions, will be in a position to enforce the repeated declarations of the Government of India on the subject.

(7) The Governor General in Council proposes therefore to constitute a Board of Scientific Advice comprising the heads of the Meteorological, Geological, Botanical, Forest, Survey, Agricultural, and Veterinary Departments, together with such other scientific authorities as may from time to time be invited by the Government of India to serve upon it. These latter will include scientific officers in the service of the Imperial and Provincial Governments whose special attainments render their assistance desirable. The Government of India hope that the Trustees of the Indian Museum, who, as custodians of the national scientific collections, have always shown an active interest in the prosecution of scientific work, will associate themselves with the scheme, and they will be addressed separately on the subject. The Secretary to the Government of India in the Department of Revenue and Agriculture, to which the scientific departments concerned are administratively subordinate, will be *ex-officio* President of the Board, and the Secretary to the Board will be selected, subject to the approval of Government, by the Board from amongst its members. The Board will review and advise generally upon the operations of the departments, with due attention to the economic side of their work, and will serve as a referee in all matters connected with the organisation of scientific inquiry in this country. It will annually receive and discuss the proposals of each departmental head in regard to the programme for investigation in his department. In cases where inter-departmental cooperation is necessary, it will rest with the Board to advise as to the lines on which mutual assistance should be given and the department to which the inquiry should primarily appertain. Where the proposed investigation falls exclusively within the domain of a particular department, the function of the Board will be confined to examining and criticising the proposals. It is not intended that the directing influence of the Board should in any way weaken departmental executive control or responsibility, and the precise manner in which, and the agency by which, any required information is to be collected or investigation carried out must be left to the heads of the departments concerned.

(8) The Board will submit annually to Government a general programme of research which will embody the proposals of departmental heads in so far as its subjects are to be exclusively dealt with in one department, and its own proposals in cases where two or more departments are to cooperate. At the end of the year it will submit to Government a brief review of the results obtained in all lines of scientific investigation, based upon the annual departmental reports and upon any papers published by individuals. Generally, the Board will act as an advisory committee to the Government of India and as an intermediary between the Government of India and their scientific officers in respect of all questions of technical research which are dealt with in the Department of Revenue and Agriculture. The Royal Society have already been good enough to offer their aid in furthering scientific work in India, and their invaluable advice and assistance will be freely invoked by the Board now constituted.

(9) To enable the Board to carry out the duties which are assigned to it, the Governor General in Council considers it desirable that its members should meet as a collective body at stated intervals for the purposes of discussion. It will probably be ordinarily sufficient to hold two meetings a year; one to consider the work of the past year and proposals for the programme of the coming year in each department; the other to settle finally those programmes subject to the approval of Government. The most convenient dates for holding these meetings will be settled in consultation with the Board.

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(1) The Surveyor General of India.
(2) The Inspector General of Forests.
(3) The Director, Geological Survey of India.
(4) The Meteorological Reporter to the Government of India and Director General of Indian Observatories.
(5) The Inspector General, Civil Veterinary Department.
(6) The Director, Botanical Survey of India.
(7) The Reporter on Economic Products to the Government of India.
(8) The Inspector General of Agriculture in India.
(9) The Director General of Archæology in India.
(10) The Chief Inspector of Mines in India.

(10) Ordered, that the Resolution be communicated to all Departments of the Government of India and Local Governments and Administrations for information and to the Departments above noted for information and guidance; and that it be published in the Supplement to the *Gazette of India*.

SOLAR PROMINENCE AND SPOT CIRCULATION, 1872–1901.[1]

IN previous numbers of this Journal (vol. lxvi. p. 248, and vol. lxvii. pp. 224 and 377) references have been made to the connection between solar, meteorological and magnetic changes, and some of the results obtained from a reduction of the solar prominences as observed by Prof. Tacchini at Rome were described.

[1] Abstract of a paper recently read before the Royal Society by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S.

The result of the discussion showed that the curve representing the variation of percentage frequency of the prominences for the whole limb of the sun indicated that in addition to the main epochs of maxima and minima coinciding in time generally with those of the maxima and minima of the total spotted area, there were also prominent subsidiary maxima and minima.

Further, dividing the sun's limb into zones of 20° in width from the equator, with a pole zone of 10°, and discussing each zone separately, the variation of the prominence percentage frequency about the equator was found to be very different from that in the higher latitudes, the former changing with the spots, and the latter exhibiting sudden outbursts just previous to the epochs of sunspot maxima, followed and preceded by comparatively long intervals of quietude.

In the present investigation the prominence observations have been discussed from a different point of view, in order to trace out, if possible, the heliographic latitudes of the chief centres of action of prominence disturbance, or in other words, to indicate the regions on the solar disc where prominences were most prevalent in each year, and see if those regions varied their positions in relation to the sun's equator.

In this way it could be determined whether such movements, if any, are subject to some periodic law, in which case it would be possible to increase our knowledge of the circulation of the solar atmosphere in regions outside those in which sunspots alone have, up to the present, been employed.

It has long been known that the centres of action of sunspot disturbances, as shown by Carrington, Spoerer and others, are restricted to particular regions on the solar surface, all of which are included in the two large zones from $\pm 5°$ to $\pm 35°$ heliographic latitude. Further, from year to year, the regions of greatest activity undergo changes of position which are periodic. Thus at sunspot maximum there is only one zone in each hemisphere in which spots are situated, the centre of this being about 18° N. and S., while at minimum there are two zones existing simultaneously in each hemisphere; the older cycle dying out in the zone the centre of which was situated in low latitudes, and the new one commencing in high latitudes, its centre being about latitude $\pm 30°$ to $\pm 35°$.

It may be here remarked that the above results are not strictly, but only generally, true, because the observations of each solar hemisphere have not been treated sufficiently in detail. If this be done by examining the behaviour of the frequency or areas of spots in, say, zones of 5° in width, then it will be found that sometimes there are actually three centres of spot activity. The reduction of sunspots in this manner for the whole period, since accurate measurements have been made, is not yet complete, but it is as well to draw the reader's attention to these facts.

Fortunately, the investigator has at his disposal two splendid series of observations of prominences made independently of each other, so that he is able to check the variations indicated in one series by seeing if they are exhibited in the other.

The observations thus discussed were made by Tacchini at Rome from 1872–1900, and by Ricco and Mascari at Catania from 1881 to 1901. Both sets of observations are handled in exactly the same way, and it will be seen later that the changes indicated in each are practically identical. It is due to the kindness of Prof. Ricco, who forwarded some unpublished data concerning his prominence observations and deductions, that the curves are complete up to the end of the year 1901.

The method of reduction adopted was to determine for each year the percentage frequency of prominence activity for every 10 degrees of solar latitude north and south. A series of curves was next drawn, one for each year, the abscissæ representing the latitudes of prominences north and south, and the ordinates their percentage frequency.

It was then found that the centres of prominence activity, or in other words, the maxima of the curves were sometimes single, sometimes double, and in one or two cases even triple in each hemisphere. This suggested that just as sometimes there are two zones of spots existing at one time, so there might be one, two, or occasionally three zones of prominences in existence in each hemisphere simultaneously.

Further, a close examination of the whole set of curves with reference to these points of maxima made it possible not only to study the changes of latitude of these points from year to year, and their positions when commencing to develop or about to disappear, but the intensity of these centres in relation to each other.

The accompanying illustration (Fig. 1) shows the curves drawn for the years 1879, 1880, and 1881, from the observations of Tacchini, and serves as examples of the curves that have been discussed; they exhibit the change from a single to a double centre of activity in each hemisphere.

Thus, in 1879, there was a prominence maximum in each hemisphere at latitudes $\pm 50°$. In the next year (1880), both these maxima had retreated further away from the equator, namely to latitudes $\pm 60°$, while another centre of disturbance began to make itself apparent at latitudes $\pm 30°$. In the year 1881, both centres in each hemisphere were strongly marked and became of about the same intensity, their mean latitudes in each hemisphere being about $\pm 30°$ and $\pm 60°$. These curves thus indicate that during these three years, the direction of motion of these centres of activity tends polewards or away from the equator.

By examining both series of observations made by Tacchini and Ricco and Mascari, and analysing the positions of the principal and subsidiary maxima for the whole period covered by the observations, the results illustrated graphically in Fig. 2 were obtained.

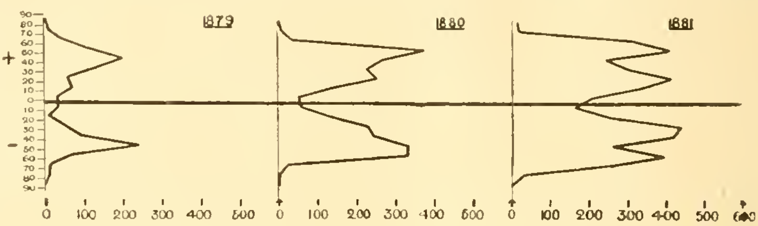


Fig. 1.—Curves illustrating the percentage frequency of solar prominences for each 10 degrees of heliocentric latitude for the years 1879, 1880 and 1881: after the observations of Tacchini.

In these figures the facts are brought together for each hemisphere separately. The medials of the lines (curves A and B) show the heliographic latitudes of the centres of prominence action; the thickness of these lines represents the relative percentage frequency of prominence action.

For the sake of comparison, three other curves for each hemisphere are shown. The first curves (C) show the mean heliographic latitude of spotted area for each hemisphere; these curves, as previously pointed out, are only generally accurate. The next curves (D) illustrate the variations of the percentage frequency of prominence action for each hemisphere taken as a whole, and are similar to those given previously.

The last curves (E) show the variation of the mean daily area of sunspots from year to year, also for each hemisphere.

With this diagram the reader will be able at once to compare the variations of the changes of latitude of prominences as determined from the Roman and Sicilian observations. He will also be able at a glance to correlate these variations with those exhibited in the other curves added for comparison. It will therefore suffice if a summary of the conclusions drawn be given.

(1) The centres of action of prominence activity undergo an apparently regular variation.

(2) The direction of motion of these centres is from low to high latitudes, the reverse of that of spots, which travel from high to low latitudes.

This is seen directly from the curves, the prominences beginning in about latitude $\pm 20°$, and moving away from

the equator until they terminate in latitude $\pm 80^\circ$. The general trend of the spots is from latitude $\pm 35^\circ$ to $\pm 5^\circ$.

(3) At epochs of prominence minima (which are concurrent with sunspot minima) these centres of action are

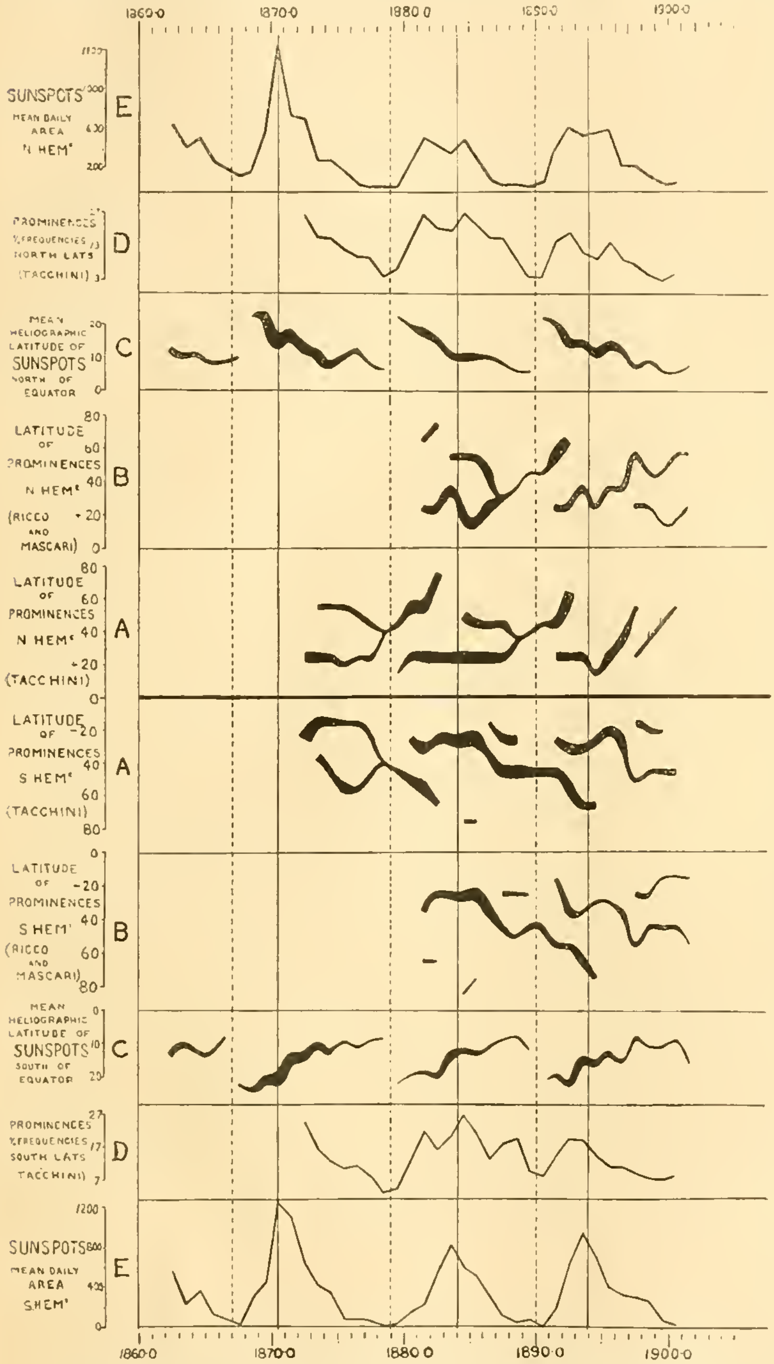


Fig. 2.—A comparison of curves illustrating the variations of the positions the centres of action of prominences (A and B) and spots (C), the percentage frequency of prominences (D), and the variation of spotted area (E). (The continuous and broken vertical lines indicate the epochs of sunspot maxima and minima respectively, the two hemispheres being taken together.)

restricted to one zone (about latitude $\pm 44^\circ$) in each hemisphere, while those of the spots occupy two zones in each hemisphere.

Since the broken vertical lines in Fig. 2 represent the epochs of prominence and spot minima, it will be seen that these cut curves C when two zones of spots are in evidence, and intersect the curves A and B when there are only single zones of prominences.

(4) At nearly all other times these centres are apparent in two zones, while those of the spots occupy only one in each hemisphere.

This deduction is true if the curves C be taken as representing simply the phenomenon generally, but it should be borne in mind, as stated previously, that a new reduction of these spot zones, which is in hand, is necessary.

(5) The subsidiary maxima exhibited by the curves representing the percentage frequency of prominence activity for each entire hemisphere are due to the presence of two well-developed centres of prominence activity in each hemisphere.

To make the comparison the subsidiary peaks on the curves D should be compared with the curves A and B, and in every case the former are accompanied by two zones of prominences.

Before concluding this article it may be mentioned that other observers, and among them Father A. Fényi, S.J., have studied this question of prominence distribution, but their discussions have been restricted to only comparatively short intervals of a few years; their results are, however, in harmony with those described here.

It is important finally to state that the deductions here made may be partially incomplete owing to the difficulty of determining sometimes whether a new centre of action has been formed or the position of an old one changed. Further, account must be taken of the fact that the material discussed does not represent the record of the percentage frequency of prominences determined from observations made on the disc of the sun (now rendered possible by the Jannsen-Hale-Deslandres method), but one obtained from observations of the phenomena occurring only at the limb of the sun. The close agreement between the observations of the different observers shows nevertheless that this latter method is of great value.

William J. S. Lockyer.

THE STATOLITH THEORY OF GEOTROPISM.[1]

The paper deals with the modern theory[2] of the mechanism by which plants are enabled to regulate their line of growth by means of the force of gravity. When an upright flower-stalk is forcibly subjected to a change of position, for instance by laying the flower-pot on its side, it responds by geotropic curvature, and finally regains the vertical. The statolith theory is not concerned with the mechanism of curvature, but merely with the question how horizontality can originate a stimulus, in other words, how the plant perceives that it is no longer vertical. It is known that in some animals, for example the Crustacean Palæmon, the faculty of spacial orientation depends on statoliths (otoliths) which serve as guides by pressure on the internal surface of the otocyst. This theory has now been applied

[1] A paper by Mr. Francis Darwin, read at the Royal Society, March 12.

[2] Published simultaneously by Haberlandt and Němec in vol. xviii. of the *Berichte d. Deutschen Bot. Gesell.*; see also *Pringsheim's Jahrb.*, vols. xxxvi., xxxviii.

to plants; the function of statoliths is believed to be performed (in Phanerogams, at least) by starch grains which are free and movable, and thus fall to the lower end of the cell. So long as the plant is vertical, the starch grains rest in a layer on the basal walls of the cells. If the plant is placed obliquely or horizontally, the falling starch grains rapidly take up a different position, and, by pressing on a new region of the cell walls, can be conceived to originate a stimulus.

The fact that the power of being gravitationally stimulated occurs in certain definite regions (*e.g.* the root-tip) suggests the existence of that type of physiological machine which we call a sense-organ. Now falling starch grains supply the physical conditions which are known, in the case of animals, to supply a sense-organ for orientation. Therefore, when we find in the root-tip groups of specialised cells provided with falling starch grains, such grains being absent in the parts of the root which have no power of geotropic perception, we have strong *a priori* evidence for the statolith theory.

This general line of argument has been fully and convincingly developed by Haberlandt and Němec, who have also supplied direct experimental evidence. Some of the latter is not quite so satisfactory. Thus Němec succeeded in destroying the starch in bean roots by embedding seedlings in gypsum, when such roots were found incapable of geotropic curvature. Němec not unnaturally put down his results to the loss of an integral part of the sense-organs. But I have shown that grass seedlings, the starch of which has been largely removed by exposure to high temperatures, not only fail to respond normally to gravitational stimulus, but also to the stimulus of light. The loss of starch must be looked at as a symptom of general inability to respond to stimulation rather than as a loss of special sense-organs.

In the autumn of 1901, feeling the unsatisfactoriness of the available methods of attacking the problem, I devised what was then a new method.[1] My point of view was that if gravitational sensitiveness is a form of contact-irritability (which must be the case if the pressure of the statoliths on the plasmic membrane is the critical event), then it might be possible to intensify the stimulus by vibration. I hoped, by applying vibration in a vertical plane to a horizontal seedling, to make the starch grains dance on the lateral walls, and by such repeated blows on the protoplasm to produce a more active geotropic response.

The result was as I expected, the seedlings which had been kept horizontal for from eight to ten minutes,[2] on a tuning-fork vibrating in a vertical plane, showed about 44 per cent. more curvature than the control specimens.

In order to make sure that the tuning-fork did not act by merely increasing the *general* irritability of the seedlings, the experiment was repeated with vertical specimens exposed to lateral illumination. In this case it was found that the curvature of the vibrated plants was only 5 per cent. more than that of the control specimens. We may therefore conclude that vibration increases the geotropic reaction, but does not materially affect heliotropism. This is precisely what might be expected on the hypothesis that geotropism is the result of tactile stimulation of the plasmic membranes lining the lateral cell walls by means of starch grains. So far as it goes, the method is therefore clearly confirmatory of the statolith theory.

FRANCIS DARWIN.

ENTOMOLOGY AT OXFORD.[3]

THE second volume of the "Hope Reports" contains the papers published by the workers in the entomological department of the University of Oxford during the years 1897–1900, and it is a cause for much congratulation to see this evidence of the very interesting and important work that is being done under the direction of Prof. Poulton with the valuable collections of tracheate arthropods possessed by the University.

[1] Practically the same method has meanwhile been made use of by Haberlandt, who has published the results in *Pringsheim's Jahrb.*, 1903.

[2] After being subjected to vibration, the plants were placed on a klinostat to prevent further gravitational stimulation. The curvature was measured after several hours slow rotation.

[3] "Hope Reports," vols. ii., iii., 1900, 1902. Edited by Edward B. Poulton. Oxford: Printed for private circulation by Horace Hart, 1901, 1903.)

In the first paper, on mimetic attraction, by Dr. Dixey, there is an important contribution to the subject which seems to be a favourite one with the Oxford entomologists, namely, the evolution of the patterns of the wings of those butterflies that form Müllerian associations. The whole theory underlying the work of Dr. Dixey and his colleagues has, it is well known, met with considerable opposition from several well-known entomologists who have studied Lepidoptera in tropical countries, and it is therefore a very satisfactory feature of this volume to find included in it a good report of the discussion that took place at the Entomological Society in 1897 at the conclusion of Dr. Dixey's papers.

The two papers on mimicry, by Prof. Poulton, which follow contain many additional facts of importance, but as they are not illustrated, they are rather difficult to follow for those who have not a special acquaintance with the butterflies; but Prof. Poulton's interesting communication to the Linnean Society entitled "Natural Selection, the Cause of Mimetic Resemblance," illustrated by five plates and several figures in the text, is an important contribution to knowledge which any zoologist may read with advantage. The volume also contains some reports on the experimental inquiry into the struggle for existence in certain common insects, and the colour-relation between pupæ of several species of butterflies and the surroundings of their larvæ.

The third volume is mainly devoted to the investigations of Mr. Guy Marshall and Prof. Poulton on the bionomics of South African insects. In South Africa entomologists have found several excellent examples of those forms of mimicry which are known as "Batesian" and "Müllerian" mimicry respectively. It was clearly important to test experimentally the value of the colours of these insects as a protection from their enemies. This Mr. Marshall has done with results which are as interesting as they are remarkable. The fact that Mantidæ and spiders exhibit unmistakable signs that certain species of Lepidoptera are distasteful to them, but are unaffected by colours whether warning or cryptic in character, suggests that birds and other vertebrates are the principal enemies which have caused the evolution of the colour patterns of these insects. The experiments with living kestrels and the results of an examination of the contents of the crops of a large number of wild birds go a long way towards a proof of the importance of the colours of both Lepidoptera and Coleoptera as a protection from their avian enemies. These and other investigations of a similar character, excellently illustrated by several plates, make up a paper of singular interest. The opponents of the evolution theory as applied to the colours of insects have a difficult task before them when they attempt to explain away the results of the experiments that are here recorded.

Space does not permit us to refer more fully to the other papers which appear in these volumes, but enough has been said to show that a very important work is being carried on in Oxford. The rows and rows of insects that the labours of entomologists in many countries have brought together in the Hope Museum are not only ticketed and arranged in systematic order, but they are made to yield up facts which, when intelligently studied, have an important bearing upon the current theories of evolution. But this is not all. Work that is done in a museum only, valuable as it may be, is of little account unless it stimulates to, and is supplemented by, experimental work in the field. That this is what museum work does lead to in Oxford is one of the most pleasing features of these volumes.

S. J. H.

MAGNETIC WORK IN MARYLAND, U.S.A.

IN a second report on magnetic work in Maryland (Maryland Geological Survey, special publication, vol. v. part i. pp. 23–98, the Johns Hopkins Press, Baltimore, 1902), Dr. Bauer gives the results of the survey which he commenced in 1896. In the earlier years the work was done mainly under the direct auspices of the Maryland Geological Survey, but subsequent to May, 1899, when Dr. Bauer took charge of the magnetic department of the U.S. Coast and Geodetic Survey, the Geodetic Survey contributed materially to it. The result, in Dr. Bauer's words, is that "Maryland now possesses the most detailed magnetic survey of any country, with the exception of Holland," there having been on the average one station to each 100 square miles.

The present report enumerates the position of all these stations, and tabulates the values of the declination, inclination and horizontal force as observed, and as reduced to the common epoch January 1, 1900. The data are also embodied in a series of charts. In the reduction to a common epoch the secular change was derived from numerous absolute observations made at Linden, Montgomery County; whilst diurnal variations were deduced from the records of the Naval Observatory, Washington. Unfortunately, owing to the disturbing action of electric trams at Washington, no satisfactory data were obtainable for the actual years occupied by the survey, and recourse was necessary to earlier records, mainly of the three years 1889 to 1891, particulars of which appear in the report. This, of course, is open to objection, on the ground that the amplitudes of the diurnal inequalities of the several elements vary from year to year. However, as both the magnetograph records and the field observations relate to years of relatively small sun-spot frequency, the objection is less serious than might appear at first sight.

Calculations are given of the probable errors in single observations with the instruments employed. The results appear fairly satisfactory in the case of the declination and inclination, but less so in the case of the horizontal force (*cf.* Table 18, p. 84). Dr. Bauer considers the weak point in the magnetometer—of the Geodetic Survey's old pattern—to have been the employment of wood in the deflection bar, and he states that the U.S. Survey is now procuring a superior type of instrument. One point that may be also worth reconsidering in this connection is the employment of 35 and 49 cms. as the two distances for deflections in horizontal force observations. Large distances have the advantage of reducing the uncertainties connected with the law of force between two magnets of finite size; but except in regions where the horizontal force is very low, distances such as 35 and 49 cms., with magnets of ordinary strength, imply small deflection angles, and the writer is inclined to think this may more than compensate for any theoretical advantage, especially in field work.

One of the interesting points discussed, and illustrated in the charts, is the existence of a considerably disturbed region near Gaithersburg, some twenty or thirty miles north-west of Washington. The abnormalities here were apparently first disclosed by special observations made with a view to the selection of a site for a magnetic observatory near Washington. The fact emphasises the dangers to which random choice of such a site may be exposed. At the end of the report there is an outline of a scheme for the complete mathematical investigation of the magnetic distribution in Maryland, but the working out of this and various other details is postponed, pending, apparently, the elaborate survey of the entire United States which the U.S. Coast and Geodetic Survey has now in contemplation. C. C.

SCIENTIFIC SERIAL.

American Journal of Science, March.—Studies of Eocene Mammalia in the Marsh collection, Peabody Museum, by J. L. Wortman. Part ii. Primates.—On ceric chromate, by P. E. Browning and C. P. Flora. An excess of chromic acid precipitates a ceric chromate of the composition $Ce(CrO_4)_2,2H_2O$ from solutions of cerium salts. Although the sulphates of lanthanum, didymium and yttrium were present, these metals were not present in the precipitate.—The effects of changes of temperature on permanent magnets, by H. B. Loomis. After giving a historical *résumé* of previous work on this subject, experiments are described showing the changes in the magnetic moment of magnets of different lengths, but of the same cross section, and on the change in distribution due to change of temperature.—On the chemical composition of axinite, by W. E. Ford. Expressed as an orthosilicate, the formula is found to be $Ca_7Al_4(SiO_4)_8$, in which the calcium may be in part replaced by varying amounts of Mn, Fe, Mg, and hydrogen, while a little Fe is isomorphous with the Al.—The electrical conductivity and absorption of energy in the electrodeless discharge, by Bergen Davis.—The geological structure of New Mexican Bolson Plains, by C. R. Keyes.—Note on the marine turtle Archelon. (1) On the structure of the carapace; (2) associated fossils, by G. R. Wieland.—The ionisation of water and of phosphorus nuclei, by C. Barus.—On a method of demonstrating Newton's rings by transmitted light, by H. N. Davis. If a number of wire rings of the same size be mounted in parallel planes, and dipped together in a soap solution, their planes being kept perpendicular to its surface, a series of films results through which light can be passed and caught on a sheet of paper, showing very beautiful colour phenomena.—Note on the amphibole Hudsonite previously called a pyroxene, by S. Weidman.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 26.—"An Attempt to Estimate the Relative Amounts of Krypton and of Xenon in Atmospheric Air." By Sir William **Ramsay**, K.C.B., F.R.S.

In these experiments 191·1 kilograms of gaseous air were passed into a Hampson's liquefier, and 11·3 kilograms of air were liquefied. This liquid air was evaporated in a partial vacuum, until only about 200 cubic centimetres remained. The residue, consisting largely of oxygen, and also containing argon, krypton and xenon, was deprived of oxygen and nitrogen by means of red-hot copper and magnesium lime, and the resulting mixture was fractionated, so as to separate the argon, krypton, and xenon. Complete separation was not achieved, but knowing the densities and volumes of the fractions of gas obtained, their relative amounts could be calculated. This method does not preclude loss of the rarer gases, but that loss, especially in the case of xenon, must have been small; the vapour-pressure of krypton at the temperature of fractionation, $-195°$, being only 2·8 mm., and that of xenon, 0·02 mm.

The results are reproduced in the following tabular statement:—

Percentage krypton in gaseous air, 0 000014 by weight.

Percentage xenon in gaseous air, 0·0000026 by weight.

Krypton equal to 1 part by weight in about 7 millions of air; by volume, 1 part in 20 millions.

Xenon equal to 1 part by weight in about 40 millions of air; by volume, 1 part in 170 millions.

As before remarked, it is not maintained that all the krypton and all the xenon have been separated; it is likely, however, that the separation of the xenon was more perfect than that of the krypton. The results are merely brought forward as the result of a careful experiment to quantitatively isolate these gases.

As a quantity of pure krypton, sufficient for determination of density, had been collected, occasion was taken to redetermine the density of that gas, with the following result, that the value, compared with $O=16$, was found to be 40·81.

The atomic weight of krypton would accordingly be 81·62; the mean of former determinations is 81·28. This is in accordance with its position in the periodic table, which lies between bromine, 80, and rubidium, 85.

"An Inquiry into the Variation of Angles observed in Crystals, especially of Potassium-Alum and Ammonium-Alum." By Prof. H. A. **Miers**, F.R.S.

The author has endeavoured to trace the changes of angle upon one and the same crystal during its growth by measuring it at intervals without moving it from the solution in which it is growing. This is accomplished by means of a telescope-goniometer in which the crystal is observed through one side of a rectangular glass trough, and the changes in the inclination of each face are followed by watching the displacements of the image of a collimator slit viewed by reflection in it.

Examined in this way an octahedron of alum (ammonium or potassium) is found to yield not one but three images from each face; and closer inspection shows that the crystal is not really an octahedron, but has the form of a very flat triakis octahedron.

When a growing crystal of alum is watched for several hours or days, it is found that the three images yielded by an apparent octahedron face continually change their position; one set fades away and is replaced by another set.

The images do not move continuously, but *per saltum*, indicating that the reflecting planes are vicinal faces which

probably possess rational indices, and must, therefore, be inclined at certain definite angles to the octahedron face; but the indices are very high numbers.

In other experiments crystals of alum were measured after growing for several hours in solution kept continually agitated in order to eliminate the action of the concentration streams. Almost no effect was produced upon the angles of the vicinal faces, which are, therefore, not due to these streams.

Every point within a crystal has at some time been a point on the surface, and has been subject to the conditions of equilibrium between crystal and solution which prevail there. It is believed by the author that a study of the vicinal planes and of the liquid in contact with them may lead to some understanding of these conditions.

In order to ascertain the composition of this liquid, its refractive index was determined by means of the same goniometer by the method of total internal reflection within the growing crystal, for alum, sodium chlorate, and sodium nitrate.

In each case the liquid in contact with the growing crystal was found to be slightly supersaturated. It was not found to exhibit double refraction even in the case of sodium nitrate.

The author suggests that vicinal faces grow upon a crystal in preference to simple forms, because the crystallising material descends upon the growing face in a shower which is not very dense.

"On a New Series of Lines in the Spectrum of Magnesium." By A. **Fowler**, A.R.C.Sc., F.R.A.S., Assistant Professor of Physics, Royal College of Science, South Kensington. Communicated by H. L. Callendar, F.R.S.

The paper records the appearance of faint lines at approximate wave-lengths 4511·4, 4251·0, 4106·8, and 4018·3 in the arc spectrum of magnesium when metallic poles are used. A mere inspection of the photographs suggests that these lines constitute a regular series, associated with the much stronger series described by Rydberg having wave-lengths 5528·75, 4703·33, 4352·18, 4167·81, 4058·45, and 3987·08, and this view seems to be confirmed by calculation.

A formula which has been found to give good results for series in general, namely

$$n = n_\infty - \frac{C}{(m+\mu)^2 - m_0},$$

gives for the two series the equations:

"Rydberg" series, $n = 26{,}601 \cdot 49 - \dfrac{107{,}071 \cdot 37}{(m + 1 \cdot 2304)^2 + 2 \cdot 13282}$,

New series, $n = 26{,}587 \cdot 4 - \dfrac{100{,}033 \cdot 6}{(m + 0 \cdot 495)^2 + 2 \cdot 38919}$,

n being the oscillation frequency *in vacuo* in each case.

The convergence frequency of the new series is as nearly equal to that of the Rydberg series as can be expected with the comparatively rough wave-lengths employed, and in each case the constant m_0 is of unusual magnitude.

It is concluded that the arc spectrum of magnesium includes two subordinate series of single lines in addition to the two well-known subordinate series of triplets. No such combination of series appears to have been previously noted in the spectrum of a metal.

"On the Dependence of the Refractive Index of Gases on Temperature." By George W. **Walker**. Communicated by Prof. J. J. Thomson, F.R.S.

Mascart found that the temperature coefficient of refractive index of gases always exceeded the theoretical coefficient given by Gladstone and Dale's law. In the case of air his results do not agree with those of Lorenz and Benoît, who found a coefficient which agrees with the theoretical law. The present paper gives an account of the author's experiments on air, H_2, CO_2, SO_2 and NH_3.

Jamin's interference method was used, and the accuracy obtained in the value of $\mu - 1$ was about one part in 600. The temperature coefficients obtained were substantially less than Mascart's values, but they still differ from the theoretical law.

"The Electrical Conductivity imparted to a Vacuum by Hot Conductors." By O. W. **Richardson**, B.A., B.Sc. Communicated by Prof. J. J. Thomson, F.R.S.

This paper is an investigation of the conditions which determine the rate of escape of negative electricity from hot metals at low pressures.

The results of the experiments are explained on the corpuscular theory of conduction in metals. Assuming that the corpuscles which strike the surface are kept in the metal at ordinary temperatures by a surface discontinuity of potential, they will escape when their kinetic energy exceeds a certain value. Calculating in this way, the number of corpuscles which escape per second, at temperature θ, is found to be

$$N = n\left(\frac{R\theta}{2m\pi}\right)^{\frac{1}{2}} e^{-\Phi/R\theta},$$

where n = the number of free corpuscles per c.c. of the metal, R = the gas constant for one corpuscle the mass of which is m, and Φ = the work done by a corpuscle in passing through the surface layer.

The saturation current is equal to N multiplied by the charge on an ion.

The saturation current, in the case of platinum and carbon, and the current under a constant voltage, in the case of sodium, where the current could not be saturated, have been shown to vary with temperature according to a formula of type $A\theta^{\frac{1}{2}}e^{-b/\theta}$ (A and b being constants), over a large range of values. The range of current examined is:—

For platinum from 10^{-10} to 10^{-3} amperes per sq. cm.
For carbon from 10^{-8} to 2 amperes per sq. cm.
For sodium from 10^{-11} to 2×10^{-2} amperes total current.

The corresponding ranges of temperature for carbon and sodium are roughly from 1000° C. to 1600° C., and from 100° C. to 450° C. respectively.

From the values of A, the number of free corpuscles per c.c. in each conductor is calculated. In the case of platinum the number agrees with that found by Prof. Patterson by another method, but the values for the other conductors are absurdly large. Reasons for the discrepancy are assigned.

The values of the discontinuity in the potential at the surface of the metal are obtained from those of b. They are found to be: for sodium, 2·45 volts; for platinum, 4·1 volts; and for carbon, 6·1 volts. The values obtained lead to the conclusion that the work required to force a corpuscle out of a metal varies, approximately at any rate, inversely as the cube root of the atomic volume.

The enormous currents obtained at such very low pressures (as much as two amperes per sq. cm. at 1/600 mm. in the case of carbon) show that the leak is not produced by the interaction of gas and metal. The results also furnish a complete explanation of the Edison effect.

"On the Evolution of the Proboscidea." By Dr. C. W. **Andrews**.

Chemical Society, April 2.—Prof. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—The dioximes of camphorquinone and other derivatives of *iso*nitrosocamphor, by Dr. M. O. **Forster**. The four possible dioximes have been prepared in a pure state, and their principal properties ascertained; from these a number of interesting derivatives have been obtained.—Reversibility of enzyme or ferment action, by Mr. A. C. **Hill**. In continuation of the author's researches on this subject attempts have been made to isolate the reversible products produced by the action of enzymes on monosaccharides. The new biose *revertose* has been obtained in this way by the action of yeast ferment upon glucose, and has been characterised by the preparation of its well-crystallised phenylosazone.—Discoloured rain, by Mr. E. G. **Clayton**. The author has examined the terra-cotta coloured deposit obtained from the rain which fell generally in the south of England on Sunday, February 22, and finds that this deposit was merely wind-borne dust from the roads and lanes of Wessex. Dr. Mill, in the discussion which followed, stated that fifty specimens collected in various parts of Europe were now being examined by the officials of the Geological Survey, and that a preliminary examination of some of these samples led him to believe that the explanation of the presence of this solid matter in the rain was less simple than Mr. Clayton had suggested.—The absorption spectra of nitric acid in various states of concentration, by Prof. W. N. **Hartley**. Photographs of the spectra of nitric acid solutions indicate

that in strong solutions there exists either a polymeride of the acid or the compound N_2O_5,H_2O; in less concentrated acid there probably exists a compound of the formula $(HNO_3)_3,H_2O$, whilst in more dilute solutions hydrates of the acid are present.—Salts of an isomeric mercaptoid form of thioallophanic acid, and a new synthesis of alkyl iminothiocarbamates, by Dr. A. E. **Dixon.**—Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone, by Dr. **Chattaway.**—Action of caustic alkalis on cinnamic acid dibromide and its esters, by Messrs. **Sudborough** and **Thompson.** α-Bromocinnamic and bromoallocinnamic acids are produced together in this reaction, and may be separated by conversion into the respective barium salts.—The composition of Caro's acid, by Dr. T. S. **Price.** The author finds that on revising his work on the basicity of this acid, using sodium hydroxide in place of barium hydroxide as a titrating agent, it may probably be represented by the formula suggested by Armstrong and Lowry.

Mineralogical Society, March 24.—Dr. Hugo Müller, F.R.S., president, in the chair.—Dr. A. **Hutchinson** described some remarkably interesting experiments which he had made on the diathermancy of antimonite. A cleavage flake of antimonite 0·29 mm. thick and 20 sq. mm. in area, perfectly opaque to light, was placed between crossed nicols and exposed to the radiation from a limelight. The plate was somewhat transparent to radiant heat, and the amount transmitted was measured by Boys's radiomicrometer. No heat was transmitted when the planes of symmetry of the crystal coincided with the planes of polarisation of the nicols, but the maximum effect was produced on the radiomicrometer when the plate was turned through 45° in its own plane. The results so far arrived at are in harmony with the orthorhombic symmetry attributed to antimonite.—Mr. J. B. **Scrivenor** described the occurrence of magnetite in the Upper Bunter Sands at Hinksford, near Stourbridge, and of anatase in the Trias of the midlands. The crystals of magnetite, measuring on an average 0·067 mm., were in cubes or octahedra. The mode of occurrence and the presence of a single set of striations parallel to the cube edge suggest that they are pseudomorphous after iron pyrites. The anatase, in crystals from 0·025 mm. to 0·06 mm., is found more abundantly in the Keuper than in the Bunter. The crystals show the forms {111} and {001}, and according to the predominance of either form are pyramidal or tabular in habit. Many of them are attached to leucoxene derived from ilmenite or sphene. The anatase has been formed *in situ*, after the deposition of the sandstone, as a decomposition product of other titaniferous minerals.—Prof. W. J. **Lewis** described a large crystal of sartorite from the Binnenthal measuring $4'' \times 1'' \times \frac{1}{3}$ An analysis by Mr. Jackson gave the following result:—Pb=42·93, S=25·32, As=31·11. Prof. Lewis also discussed some peculiar twinned crystals of copper-pyrites and cerussite.—Mr. W. B. **Giles** contributed notes on howlite and other borosilicates from the borate mines of California. One of these, for which the author proposes a new name, is a white amorphous mineral resembling in appearance pandermite; the results of two closely agreeing analyses of material from different localities corresponded to a formula

$$8CaO.5B_2O_3.6SiO_2.6H_2O.$$

Mr. Giles also described a tantalite from Green Bushes, W. Australia, which contained 85 per cent. of tantalic with very little niobic acid.—Mr. J. Allen **Howe** exhibited specimens of peculiar pseudo-stalactitic growths of calcite from the north of England.

Geological Society, March 25.—Prof. Charles Lapworth, F.R.S., president, in the chair.—On a new species of Solenopsis from the Pendleside Series of Hodder Place, Stonyhurst (Lancashire), by Dr. Wheelton **Hind.**—Note on some Dictyonema-like organisms from the Pendleside Series of Pendle Hill and Poolvash, by Dr. Wheelton **Hind.**—The geology of the Tintagel and Davidstow district (northern Cornwall), by Mr. John **Parkinson.** The country described and mapped extends from the coast eastward towards St. Clether. In the eastern part it extends to the Brown Willy mass of granite. Except in the southern coast region, the strike is fairly uniform in an east-south-easterly and west-north-westerly direction, the beds having a northerly dip; but north and south of Tintagel Head the higher members appear, greatly faulted. The most distinctive rocks, utilised as a datum for mapping, are a group of ashes and lavas. Bluish-black slates and fine laminated quartzose beds overlie and underlie this volcanic series. The remaining rocks are phyllites, closely resembling those from the Ardennes. The author divides them into four groups. The highest of these (Tredorn Beds) overlies the uppermost division of the Blue-Black Slates. The beds underlying the Lower Blue-Black Slates (Hallwell Cottage Beds) are banded phyllites, with quartzose laminæ. The underlying phyllites (Penpethy Beds and Slaughterbridge Beds) contain no distinctive mineral. Taken as a whole, the phyllites consist of a sericitic and chloritic groundmass containing unoriented crystals of white mica, micaceous ilmenite, hæmatite, and minor quantities of tourmaline and rutile.

Linnean Society, April 2.—Prof. S. H. Vines, F.R.S. president, in the chair.—The minutes of the general meeting of March 19 were read and confirmed.—Mr. A. Gepp read a paper on behalf of the author, Mrs. Antony **Gepp** (Ethel S. Barton), entitled "List of Marine Algæ collected at the Maldive and Laccadive Islands by Mr. J. Stanley Gardiner." The author stated that there appears to be no record of the marine Algæ of these islands. The list now presented includes one new species, *Liebmannia Laccadivarum*, but the bulk of the remainder are already known from the Indian Ocean.—Dr. D. T. **Gwynne-Vaughan** gave a lantern demonstration of his paper on the comparative anatomy of the Cyatheaceæ and other ferns.

PARIS.

Academy of Sciences, April 6.—M. Albert Gaudry in the chair.—Memorial notice of Sir George Gabriel Stokes, by M. **Mascart.** Sir George Gabriel Stokes had been correspondant of the Academy of Sciences for the department of physics since 1879. He was nominated as a Foreign Associate in 1900.—On animal heat, by M. A. **Chauveau.** A consideration of problems raised by a note of Lord Kelvin's on the regulation of temperature of warm-blooded animals. It is shown that the organism is much less resistant to a raised than to a lowered external temperature. A fall of 60° C. in the external temperature has no effect on the temperature of the body, whereas a rise of 60° C. soon causes the body temperature to increase several degrees, and death quickly follows.—Note by M. **Laveran** referring to M. Chauveau's communication. It is pointed out that man is much more competent to withstand an increase of exterior temperature than most animals. This is borne out by the author's experience at Biskra, where the temperature sometimes reaches 50° C. in the shade.—On Anopheles and malaria, by M. A. **Laveran.** Mosquitoes from paludal districts in all parts of the world have been examined by the author, and it is proved that almost invariably abundance of Anopheles coincides with the prevalence of malaria. Anopheles may be met with in healthy localities, as they are not in themselves dangerous, only becoming so when infected from malarial patients. The different species of Anopheles are not equally effective in spreading the disease.—On waves of the first order in a vitreous medium, by M. **Duhem.**—Report of the Equatorial Geodesic Commission. The work of the commission in the Andes was much hindered by the exceptional weather conditions. At the post of Mirador, altitude 4000 metres, observations were nearly impossible for a period of three months, owing to incessant fogs and storms.—On the volcanic conditions of Martinique; result of the mission to Martinique, by M. A. **Lacroix.**—The fiery clouds produced in the eruption of Mont Pelée have been observed by the author; they consist of large volumes of hot gases and vapours, carrying great quantities of fragmentary products, and are the principal agent of destruction.—On a remarkable property of several developments employed in mathematical analysis, by M. **Stekloff,** presented by M. Émile Picard.—On a new transformation of curved surfaces, by M. C. **Guichard.**—On a form of the relation $\phi(p, v, t)=0$, by M. Honoré **Moulin,** presented by M. E. H. Amagat.—On a new method of rendering horizontal the optical axis of a telescope, by M. Alphonse **Berget,** presented by M. Lippmann.—On observations of atmospheric electricity at the summit of Mont Blanc, by M. G. **le Cadet,** presented by M. Jannsen. The author finds that the diurnal variation of potential in fine weather at the summit of Mont

Blanc shows a simple oscillation, maximum about 3–4 p.m., minimum about 3 a.m.—On magnetic dichroism of liquids, by M. Georges **Meslin.** Solutions of bichromate of potassium in turpentine and in carbon disulphide have the property of absorbing to unequal extents the rays parallel to, and perpendicular to, the magnetic field. This result is exhibited by the whole extent of the spectrum.—On the colour of mercuric iodide at different temperatures, by M. D. **Gernez.** The author has been able to keep yellow mercuric iodide unchanged for years in a vacuum. If the yellow crystals be cooled down from above 126° C. to about −192° C., they become almost white, while the red crystals at this temperature become orange-yellow.—On derivatives of plumbic acid, by M. Alb. **Colson.** Lead tetracetate may be obtained by the action of chlorine on a solution of lead acetate in acetic acid.—On the preparation of the crystalline sulphides of zinc and cadmium, by M. Georges **Viard.** If the vapours of zinc or cadmium chlorides, diluted with carbon dioxide, be passed over the sulphides of various metals, *e.g.* SnS, crystalline ZnS or CdS is formed.—On the action of alkaline earth bases on salts of the pyrogallol sulphonic acids, by M. Marcel **Delage.** If a solution of $Ba(OH)_2$ be added to one of barium, strontium, or calcium pyrogallol sulphonate, coloured bodies of complex constitution are formed.—On organic heats of combustion, by M. P. **Lemoult.** The theoretical and calculated values for the sixty cases given are very concordant.—On nitrated cellulose, by M. Léo **Vignon.** The product obtained gave analytical results agreeing very well with an oxycellulose trinitrate.—Association of bacteria with Ascobolus, by M. **Molliard.**—Action of calcium oxalate in the nutrition of plants, by M. **Amar.** The crystals of calcium oxalate become less numerous as the distance from the vein of the leaf increases; they are probably a product of excretion.—On the localisation of æsculin and of tannin in the chestnut tree, by M. A. **Goris.** The reaction made use of to detect æsculin is the blood-red colour produced by the consecutive action of concentrated nitric acid and ammonia.—On new fossil fungi and algæ of the coal period, by M. B. **Renault.**—On the Lycopodinaceæ of the Trias in Lorraine, by M. P. **Fliche.**—On nephrotoxins, by M. H. **Bierry.** If the bruised kidney of a dog be introduced into the blood of a rabbit, the blood becomes powerfully toxic, and produces strong albuminuria when injected into a dog. Nucleo-albumins derived from the kidneys produced the same effects.—On the speed of flow of subterranean waters, by MM. E. **Fournier** and A. **Magnin.**

DIARY OF SOCIETIES.

THURSDAY, April 16.

Mathematical Society, at 5.30.—Exhibition of the Logo-Logarithmic Slide-rule: C. S. Jackson.—On the Deduction of Schlömilch's Series from a Fourier Series, and its Development into a Definite Integral: R. F. Gwyther.—On those Functions which are Defined by Definite Integrals with not more than Two Singularities: E. T. Whittaker.—Note on Exact Solutions of the Problem of the Bending of an Elastic Plate under Pressure: Prof. A. E. H. Love.—Relations between Points (in a Plane) having Conjugate Complex Coordinates: Prof. A. Lodge.

Linnean Society, at 8.—On some Points in Connection with the Ordinary Development of Vaucheria Resting Spores: Dr. H. Charlton Bastian, F.R.S.—The Labial and Maxillary Palpi in Diptera: W. Wesché.—On Freshwater Rhizopods and their Classification: Prof. G. S. West.

FRIDAY, April 17.

Epidemiological Society, at 8.30.—The Seasonal Incidence of Typhoid Fever and Summer Diarrhœa: Dr. J. T. C. Nash.

SATURDAY, April 18.

Geologists' Association.—Excursion in Conjunction with the Geological Section of the Croydon Natural History Society. Directors: N. F. Robarts and W. Whitaker, F.R.S. Members meet at New Cross Station (L. B. & S. C. R., down platform), at 3.21 p.m. Object: To see the Reopening of the Cutting S. of the Station, showing the Junction of the London Clay with the Beds below.

MONDAY, April 20.

Victoria Institute, at 4.30.—The Geological Conditions of the West Indian Volcanoes: Prof. J. W. Spencer.—On Volcanic Action, with Special Reference to the Recent Eruptions in the West Indian Islands: Prof. J. Logan Lobley.

TUESDAY, April 21.

Royal Institution, at 5.—The Blood and some of its Problems: Prof. Allan Macfadyen.

Royal Statistical Society, at 5.—Agricultural Wages in England and Wales during the last Fifty Years: A. Wilson Fox.

Institution of Civil Engineers, at 8.—The Decay of Metals: James T. Milton and William J. Larke.

Zoological Society, at 8.30.—On the Geographical Distribution of Spiders of the Order Mygalomorphæ: R. I. Pocock.—On some Mammals collected by Capt. H. N. Dunn in the Soudan: Oldfield Thomas, F.R.S.—Linnæus and Hunter on Feather tracts: Henry Scherren.

WEDNESDAY, April 22.

Society of Arts, at 8.—Modern Bee Keeping: Walter F. Reid.

Chemical Society, at 5.30.—The Velocity and Mechanism of the Reaction between Potassium Ferricyanide and Potassium Iodide in Neutral Aqueous Solution: F. G. Donnan and R. de Rossignol.—A Microscopic Method of Determining Molecular Weights: G. Barger.—Note on the Spectrum of Pilocarpine Nitrate: W. N. Hartley.—Isomeric Change of Dipropionanilide into Propionyl-*p*-aminopropiophenone: F. D. Chattaway.—Note on the Formation of the Di- and Hexa-Methylammoniacal Chlorides of Cadmium: W. R. Lang.

THURSDAY, April 23.

Royal Institution, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

Society of Arts, at 4.30.—The Province of Sind: Dr. Herbert M. Birdwood.

Institution of Electrical Engineers, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms: M. B. Field. *And, if time permit.*—Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals: W. Aitken.

FRIDAY, April 24.

Royal Institution, at 9.—Some Recent Investigations on Electrical Conduction: The Hon. R. J. Strutt.

Institution of Civil Engineers, at 8.—Bacterial Sewage-Disposal Works, at Ash, Dover: H. S. Watson.

Physical Society, at 5.—An Electrical Thermostat: H. Darwin.—Dimensional Analysis of Physical Quantities and the Correlation of Units: A. F. Ravenshear.—Note on the Dimensions of Physical Quantities: R. J. Sowter.

Institution of Mechanical Engineers, at 8.—Address by the president, J. H. Wicksteed.—The Education of Engineers in America, Germany and Switzerland: Prof. W. E. Dalby.

CONTENTS.

THURSDAY, APRIL 23, 1903.

SCHOOL GEOMETRY REFORM.

Practical Exercises in Geometry. By W. D. Eggar, M.A. Pp. xii+287. (London: Macmillan and Co., Ltd., 1903.) Price 2*s.* 6*d.*

Geometry. An Elementary Treatise on the Theory and Practice of Euclid. By S. O. Andrew, M.A. Pp. xi+182. (London: John Murray, 1903.) Price 2*s.*

Theoretical Geometry for Beginners. By C. H. Allcock. Pp. ix+135. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.* 6*d.*

Elementary Geometry. By W. M. Baker, M.A., and A. A. Bourne, M.A. Books i. and ii., pp. xxix+126; price 1*s.* 6*d.* Books i.–iii., pp. xxix+213; price 2*s.* 6*d.* Books i.–iv., pp. xxix+272; price 3*s.* Books i.–vii., pp. xxix+474; price 4*s.* 6*d.* (London: George Bell and Sons, 1903.)

The Elements of Geometry. By R. Lachlan, Sc.D., and W. C. Fletcher, M.A. Pp. xii+207. (London: Edward Arnold, n.d.) Price 2*s.* 6*d.*

Plane Geometry. Adapted to Heuristic Methods of Teaching. By T. Petch, B.A. Pp. vii+112. (London: Edward Arnold, n.d.) Price 1*s.* 6*d.*

Euclid: Books v., vi., xi. By Rupert Deakin, M.A. Pp. 144. (London: W. B. Clive, 1903.) Price 1*s.* 6*d.*

A Short Introduction to Graphical Algebra. By H. S. Hall, M.A. Pp. 49. (London: Macmillan and Co., Ltd., 1903.) Price 1*s.*

THE movement having for its object the improvement of the teaching of elementary geometry is making rapid progress; witness the enthusiastic support of the teachers, the adhesion of important examining bodies, and the number of new text-books now appearing in rapid succession.

In the "Practical Exercises in Geometry," by Mr. W. D. Eggar, we have a contribution of remarkable freshness. In this valuable text-book the method pursued is on lines indicated long ago by W. G. Spencer, the father of Mr. Herbert Spencer, in his "Inventional Geometry,"[1] a little work that should be known to all teachers. The principal advance on Spencer's geometry is in the amount of *quantitative measurement* introduced, and in the use of squared paper methods. The author describes his book as "an attempt to adapt the experimental method to the teaching of geometry in schools." He says:—

> "The main object of this method, sometimes called 'heuristic,' is to make the student think for himself, to give him something to do with his hands for which the brain must be called in as a fellow-worker. The plan has been tried with success in the laboratory, and it seems to be equally well suited to the mathematical class-room."

And readers of the book will agree that the author has very good grounds for this opinion.

The first five chapters are devoted entirely to the measurements of lines, arcs and angles. The author wisely uses only decimal scales. These are the inch and the centimetre scales; in regard to the latter it is no small advantage for a youth to be trained so as to be able to think in metric units. The degree of accuracy aimed at will appear from the requirement that students are asked to measure lengths correctly to within the one-hundredth part of an inch. This, however, will prove to be rather trying for lines in some of the figures, in the absence of short cross lines defining their ends. Several methods are suggested of how to measure the circumference of a circle, but the use of tracing paper and a pricker, perhaps the best of these, is overlooked.

The student is next introduced to the use of set-squares, and the notions of parallel and perpendicular lines naturally follow. Explanations are then given of how areas and volumes are measured, the subject being illustrated by the use of squared paper, unit cubes, graduated flasks, weighing, &c. The quantitative work is here largely arithmetical. This free admixture of arithmetic and drawing is, in fact, a feature throughout the book, and one marvels at the long unnatural divorce which has existed between the two in the past.

Chapters xi. and xii. are devoted to some fundamental constructions, such as the bisection of lines and angles, and the division of lines. The student by this time is quite familiar with the notion of a locus.

So far the work has been more or less of preparation. The student is now led to study more particularly the properties of triangles, quadrilaterals, circles, proportionals and similar figures. But there is no change in the method of treatment. By judicious directions, by questions and suggestions, the reader all the while seems to be discovering new truths for himself by drawing and measurement, and his interest is secured and maintained. Then follows the reason, given quite informally, perhaps by a mere hint, but none the less perfectly logical, and absolutely convincing and satisfactory, and the student feels that he has, or could have, discovered this also.

The concluding chapters relate to mensuration rules, the graphical solution of quadratic equations, the construction of scales, and graphs.

Material is provided at the ends of some of the chapters for the student to exercise himself in riders, constructions, and numerical examples. The answers to the latter are collected at the end of the volume.

The course above outlined is developed on satisfactory lines, and may be regarded as a first important instalment to the new literature of the subject. Taught in this manner, geometry would seem likely to become the most popular, as well as the most illuminating branch of elementary mathematics. It ought to replace not only Euclid, but the wretched system of practical plane geometry now in vogue in our elementary day schools. The course includes everything contained in the first six books of Euclid that a boy need know; and he knows it so thoroughly that any subsequent study of Euclid or its equivalent will add little to his knowledge of geometry, whatever may be its other merits or demerits.

We notice that the use of the T-square is not introduced at all. This seems a pity, in view of its great utility and of future developments.

While in general agreement with the author, we should like to see his course of study extended. What-

[1] Published by Williams and Norgate.

ever may be added, however, should be carefully selected, having regard to modern conditions. Very little additional matter will be taken from Euclid. We think the book would have been improved by a chapter on the solution of right-angled triangles, using the trigonometrical tables given at the end of the volume, results obtained graphically being verified by calculation. In subsequent work graphical and numerical computation would go on side by side. There are calculations relating to right-angled triangles quite as important as that of Euc. i. 47, and the drawing class seems to be the proper place in which to teach them to beginners. What better examples than the trigonometrical functions are to be found of ratio and proportion? Consider what a satisfaction it must be to a boy to find himself in possession of and familiar with this powerful modern weapon. And, moreover, the knowledge gained is of the utmost importance. In connection with this part of the subject, the radian measure of an angle should not be neglected; it is very desirable that a student should be trained so as to be able to think in radians as well as in right angles and degrees.

Next, a course seems very incomplete without some notion of projection, and how lengths and angles in three dimensional space are measured and represented. Following the author's plan, the principles of Euclid xi. would be inculcated along with exercises in descriptive geometry, involving quantitative measurement. This can be rendered quite interesting.

And lastly, one of the most fruitful additions that could possibly be made would be to introduce the idea of a vector, giving the triangle or parallelogram law, with some of its consequences. Geometry is essentially a vector subject, and an early knowledge of vectors would have far-reaching effects.

In the "Geometry" by Mr. S. O. Andrew we have another text-book in which exercises in drawing and deductive reasoning are carried on together, so that the student acquires some practical acquaintance with the subject-matter. But the work is not based sufficiently on accurate quantitative measurement, and the author seems satisfied with drawing of an inferior quality. We find no description of what sort of scales are suitable for measuring lengths. There is no information as to the manner of using and testing straight edges and squares. In the absence of any guidance to the contrary, the student is sure to use soft blunt pencils. There are no numerical answers given to any of the exercises.

But a teacher using the book could, to some extent, supply these omissions, and would find the volume very serviceable; it is the result of practical teaching experience. It covers substantially the same ground as the book previously considered, with a chapter on solid geometry and orthographic projection. Loci and graphs are introduced, and trigonometrical tables are given and explained, but are made very little use of in the text.

The text-books of Messrs. Allcock, Baker and Bourne, Lachlan and Fletcher, and Petch are alike in having for their main object the development of a system of formal geometry on Euclidean lines. The changes they introduce with the object of improving geometrical teaching are such alterations as the revision of the definitions and axioms, the rearrangement and regrouping of the propositions, the employment of arithmetic, algebra, loci, &c. Euclid's *form* of reasoning has in all cases been retained. Experimental geometry is not made prominent; it is brought in rather in connection with the examples which follow the propositions.

As it appears to us, these books are not sufficiently free of the Euclidean tradition to make them suitable for boys at school. They are more fitted for subsequent study. The presentation of the substance of Euclid i. by Allcock is excellent, and may well replace Euclid when the time comes for taking up the philosophy of the subject. In the volumes by Messrs. Baker and Bourne there is an introductory chapter on experimental geometry, extending over twenty pages, comprised of nearly two hundred exercises, ranging over the whole subject up to the end of Euclid vi., and intended to make the student practically acquainted with the ground to be subsequently covered. This chapter is a valuable and extremely suggestive one, so far as it goes; if the material had been set out in greater detail, and worked in along with the deductive geometry and accorded equal importance with the latter, a geometry quite suitable for youths would have been the result. As text-books of formal geometry these manuals by Messrs. Baker and Bourne can be strongly recommended. They cover the ground usually studied, including Euclid xi., and there are chapters on graphs and mensuration formulæ. They are beautifully printed and arranged, and contain many practical exercises.

Mr. Deakin's Euclid is written on strictly orthodox lines; it contains some useful notes and exercises by the author. The only evidence of any influence of the reform movement is at the end of Euclid vi., where an abstract is given of the recommendations of the committee of the Mathematical Association of 1902.

The little book on "Graphical Algebra" by Mr. Hall is intended to accompany the well-known "Elementary Algebra" of Messrs. Hall and Knight. It is concerned with graphs and squared paper work, and illustrates some part of the service which geometry is rendering to algebra. Some of the examples are evidently taken from previous publications, though the author forgets to acknowledge their source.

J. HARRISON.

SYSTEMATIC PETROGRAPHY.

Quantitative Classification of Igneous Rocks Based on Chemical and Mineral Characters, with a Systematic Nomenclature. By Whitman Cross, Joseph P. Iddings, Louis V. Pirsson, and Henry S. Washington, with an Introductory Review of the Development of Systematic Petrography in the Nineteenth Century, by Whitman Cross. Pp. x + 286. (Chicago: the University of Chicago Press; London: Wm. Wesley and Co., 1903.) Price 8s. net.

BY the very first page this book is defined as dealing with "the science of petrography." Petrology is "the broad science or treatise of rocks"; petro-

graphy is "the descriptive, systematic science, leading to the nomenclature of these objects." This elevation of systematic description to the rank of a science disarms a certain amount of criticism. The able authors, who confront us after a long period of careful thought and collaboration, take their stand here as petrographers, with all the dignity of a well marshalled mediæval "battle." Right and left we may read the blazon on their shields; their pages trumpet forth the titles by which they would be known; they stand for system and for order, for a "hierarchical classification" (p. 3), against a hitherto careless and indifferent world.

If the four champions are, for the time, not petrologists, but petrographers, still more strongly do they stand apart from the geologists. We have usually regarded rocks, and the lessons to be learned from them, as coming within the scope of the geologist. Just as the mineralogist begins with molecular aggregates, so the geologist begins with mineral aggregates, and from them seeks to read the history of the world. No such agreeable considerations are to be tolerated in the science of petrography. Our authors, some of whom, at least, have long been welcomed as geologists, have entered the field under sober vows of self-denial. The object of the petrographer (p. 63) is "to secure logical excellence for his system."

We are truly grateful for Mr. Cross's term "hierarchical." It seems to define the situation, and to add zest to the devious paths of heresy in which most of us at present wander. We even foresee that the petrologists—not the petrographers—will in the future be divided into two schools, those who desire a classification and those who would rather be without it. For the first school, there is much salvation in the present treatise; it will, indeed, give them as logical a classification as the imperfect human mind can conveniently grasp. As such, it has been welcomed by Mr. F. D. Adams in the pages of *Science* (February 27, 1903).

The reader, in mere fairness, must consider the principles of any classification independently of its nomenclature. The first proposition here made is (p. 128) to divide igneous rocks into five "classes," according to the minerals which might have crystallised, under certain conditions, from the magma represented by the chemical analysis of the rock. On the one hand we regard the group of minerals, quartz, felspars, felspathoids, zircon and corundum; on the other the group pyroxenes, olivine, magnetite, hæmatite, &c., in fact, broadly speaking, the ferromagnesian group (p. 116). The five classes are simply established according to the numerical predominance of one group or the other.

Each of the two mineral groups is divisible into two subgroups; in the first three classes of rocks, the silica-alumina group of minerals is of such importance that five "subclasses" may be based on the relative proportion of the two subgroups within this group in each particular rock. Similarly, the two subgroups of minerals of the ferromagnesian group are utilised to establish five subclasses of rocks inside classes iv. and v. (p. 130).

We may now pass on to "orders." One mineral subgroup in each subclass of rocks predominates over the other subgroup; on this basis we obtain orders of rocks, of which there are as many as nine in each of the first three subclasses of each of the first three classes (p. 132). Orders, with equally strict logic, may be divided into "sections."

So far, the possible minerals have given a position to the rock. We may, however, consider the "general character of the bases in the minerals of the preponderant group in each class," which enables us to assign a "rang" to the same rock. Rangs are so absorbing that we confess to some annoyance when we come on p. 141 to "grads," which look like another exercise in subclasses, a matter that we have already taken carefully to heart. "Subgrads," a further division, need not be discussed in the present brief review.

Suddenly it flashes upon us that we have all this time been dealing with a possible but wholly imaginary object, and not with the rock which we have plucked, after miles of travel, from its parent mountainside. Let not this thought obtain the mastery; it is a temptation of the evil one, whom we may call Lossen, or Judd, or Rosenbusch—for even the last-named author is now classed with the geologists. The rock, for hierarchical purposes, has both a body and a soul; the former (p. 147) is its "mode," or actual mineral composition; the latter is its "norm," or standard mineral composition, as obtained by calculation. Some species, of saintly character, have modes coincident with their norms; where this is not the case, the difference demands investigation.

Herein clearly lies the great value of precision in petrography, such as our authors introduce. The definite statement of the facts is obviously of first importance, before we seek to explain the deviation of mode from norm by experimental or observational geology. In such a statement, geological considerations are out of place; geological conditions have controlled the mode, but should not influence the name and rank assigned to the resulting product in a system of pure petrography. If we very properly reject geological age as a factor in rock-classification, so it is equally desirable to reject such groupings as "plutonic," "dyke-rocks" and "volcanic." Pp. 149 to 153 of the present book go far indeed to justify the precision of its system.

When, however, we come to part ii., on nomenclature, we prefer to leave the reader to go forward by himself. Every science must have its technical phraseology, and Mr. Bather justly objects[1] to the replacement of *Rhinellus furcatus* by "the fork-tailed Nosey." Yet those who multiply technical terms, and especially technical adjectives, forget that even the most specialised of specialists is not dealing with each term once a day; nor is he forced to describe a natural object as if a railway-whistle had sounded which summoned him for ever from the scene. May not scientific workers take heart, and gain grace, from the cultured descriptions of pictures in an ordinary well conducted catalogue? What are rocks but pictures, recording the most varied incidents in the history of the ground be-

[1] See the *Museums Journal*, vol. ii. p. 138.

neath us? The canvas was prepared of old time, but the design first traced upon it has been modified again and again by natural agents; new pigments have been absorbed by it, while others have changed their nature, and have often become more beautiful and permanent in their decay. The describer of a rock, the petrographer, may well pause before it, and proceed to fill in the details with an almost affectionate care.

Is life, in fact, so brief that the name assigned to each object must express it completely in its habit as it lived?

We have no right to raise objections to the scheme of these four serious and conscientious workers, on the ground that it involves a considerable tax upon the memory. Yet we may question the advantage of compressing all our information into the tabloid form, and leaving the reader to dissect the compound in order to find out its contents. Abbreviation goes far when a rock, already accepted as *dosalane* in class, that is, with silica-*al*umina minerals pre*d*ominant in its norm, is also found to be *grano-hornblende-germanare*.[1] In the scheme proposed, there is special virtue in the last syllables of such words. Yet what would be gained for the correct appreciation of a work of art if it were described as *samsodelic angelo-italare*, because it contained (or might in other circumstances have contained) Samson and Delilah, and belonged to the Italian school of which Michael Angelo is the representative? Or should we describe the House of Commons for 1903 as *unanim-hibern-britannare*, and also as *dochamberlane*, on account of the predominance of a particular constituent? "Is't not possible to understand in another tongue?"

Were we to comment on all the details selected as a basis for rock-classification, we should unduly extend the present notice. The historic review is of great interest and value, and the proposal (p. 180) to revert, for field-purposes, to the old loose signification of granite, diorite, &c., has some points in its favour. Similar reasoning, however, would allow us to speak of a mineral as a fossil; nor are the historic authorities always correctly invoked by the reformers of petrography. D'Aubuisson, that is to say, Haüy, from whom he had the term, does not (p. 182) use aphanite in the wide sense stated; for him, it is a compact diorite, with amphibole predominant over felspar. If we loosen the bonds of peridotite (p. 183), we must go back to Cordier, and use it for a basalt or dolerite rich in olivine. As for felsite (p. 184), the authors can hardly have realised the odd mixture of materials associated under the name by Gerhard. It may be sufficient to mention labradorite felspar and the pitchstone of Meissen as felsitic rocks in the sense of the inventor of the term.

However, we conclude as we began; there are persons who desire classification in order to promote accuracy of comparison. Such accuracy must be welcomed by every geologist, where individual specimens are concerned. Whether it is of so much service when we consider rock-masses as portions of the earth's crust is a question for the worker in this or that particular district. At any rate, our authors have sought perfection in the domain on which they set their gaze. To all of us is the mission sent, of Sir Persalane, Sir Salfemane, Sir Dofemane, and Sir Perfemane—for we cannot but regard these names (p. 102) as those of champions seeking for a Grail. The path is lit by their high endeavour, even if we may not follow it to the end.

GRENVILLE A. J. COLE.

[1] Mr. H. Stanley-Jevons (*Geological Magazine*, 1901, p. 313) has already attempted such terms as *Sodali-mudalkalite* and *Ægiaugi-natrijolite*. It would of course be similarly possible to express a whole chemical analysis by a skilfully constructed word some decimetres in length.

ALTERNATING CURRENT ENGINEERING.

Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke. Pp. 141. (Brunswick: Friedrich Vieweg und Sohn, 1903.) Price 3.60 marks.

THIS volume, the third issue of "Elektrotechnik in Einzel-Darstellungen," comes as rather a surprise after the first two highly specialised parts of this series on lightning arrestors and the parallel running of alternators. In order to peruse the book with profit, the reader must be acquainted with the fundamental theory of electricity and magnetism, and also with the general laws of electrical engineering. Ability to use the differential and integral calculus is also necessary, in order to understand the mathematical reasoning given.

The book is divided into six parts—introduction, the simple alternating current circuit, mutual induction, capacity phenomena, composite wave forms, and polyphase currents. The arrangement and scope of the book will render it of most use to the practical electrical engineer, who, though using certain symbols and equations every day, yet is apt to lose sight of their fundamental origin, and, in order to comprehend new problems, needs, now and then, to refresh himself in the theoretical basis of his work. Such a simple thing as the measured value of an alternating current is an example of what we mean. Every engineer knows, of course, that what he calls the current is the root of the mean of the squares of the instantaneous values of the current. Why this should be, and to prove the reason why, would, we think, puzzle a good many men who would be very much insulted if they were told that they could not do so. The why and the wherefore of this matter is set forth in the introduction of the book. Part ii. deals chiefly with the application of Ohm's law to the alternating current circuit, the work done by an alternating current and the use of vectors. The third and largest part of the book is concerned mostly with the laws of the transformer. No attempt to treat of design is made, nor is the practical performance of any actual machines studied. The subject is treated purely from the theoretical engineering point of view.

Part iv., on capacity, is very short, and does not give much beyond the deduction of the formula for the calculation of the effective current in a circuit containing resistance, self-induction and capacity, and also showing the conditions under which electrical resonance can occur. Part v. is the most useful of the book, as it serves as a guide to the difficult task of dealing with the irregular wave-forms given by alternators and transformers. The appendix can be used in con-

junction with this division of the book, as it contains a set of formulæ, deduced from Fourier's theorem, with the coefficients worked out, for calculating the harmonics (up to the 11th) of an alternating current waveform. The author states that in all curves actually met with in practice, the 13th and higher harmonics can be neglected, as they are so small. This is, however, not true. It has been recently shown that in the E.M.F. curve of the alternators of the Glasgow Corporation Tramways, the 13th harmonic is one of the most important, and alternators may very well exist in which the 15th and 17th harmonics are the largest.

The last division, on polyphase currents, does not do more than show the general star and delta relationships, and contains a chapter on the measurement of three-phase power.

As stated above, the book will be mainly useful to practical engineers who desire to have at hand a volume which will help them out of mental entanglements which arise from time to time in working with alternating currents. The general theory (general differential equation) of the electric circuit is not dealt with at all. This being so, we of course find no mention of the exponential terms which vanish with time, and which appear in the full solution of the general equation. These, though airily dismissed by many writers, are really of the utmost importance, as on them depends the theoretical treatment of all the important phenomena met with in electric switching, and oscillations set up by sudden changes in the current flowing. These exponential terms certainly constitute a "Grundgesetz," and as such should have been mentioned. The work is closed by a table of formulæ, but that greatest sin of omission, no index, is committed.

C. C. G.

THE PRINCIPLES OF DYEING.

The Principles of Dyeing. By G. S. Fraps, Ph.D., of North Carolina College. Pp. xii+270; with 22 illustrations in the text. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1903.) Price 7*s.* net.

IN the preface to this work the author states that "it attempts to apply to the teaching of dyeing the same methods of class-room work, coordinated with experiments in the laboratory, which have proved so successful in the teaching of inorganic chemistry and other branches of science," and its novel feature consists in the insertion, interspersed throughout the text, of a series of experiments, seventy-nine in number, which the student is to carry out in the laboratory.

Although no such division is made by the author, the book may conveniently be considered in two portions, chapters i. to vi. giving a general survey of the subject in 53 pages, while the remaining sixteen chapters, occupying 200 pages, are devoted to a systematic amplification.

This larger portion of the book follows the lines adopted in most modern text-books on dyeing, and little need be said in reference to it beyond the obvious remark that, even with the most careful condensation, it is not possible, without dangerous generalisations, to compress into 200 small pages any adequate discussion of the various matters treated under the headings cotton, linen, wool, silk, bleaching, scouring, machinery, general observations, direct cotton colours, basic colours, acid colours, mordant colours, insoluble colours, mercerisation, dyeing of unions, theory of colour, spectrum analysis, dye testing and detection of dyes. The inevitable result of too general statement follows; for example, on p. 251 the following sentence is found:—"A dye on cloth has nearly the same absorption-spectrum as a solution of the dye of corresponding strength." This is by no means the case, since the hue of the dyed fabric often differs considerably from that of a simple solution of the dye. In the same section a normal spectrum is figured, while the description refers to the prismatic spectrum.

Less importance, however, should be attached to slight errors of statement than to the general scope of the work, and from this point of view the chief interest attaches to the preliminary chapters, to which the author's statement, quoted in the first paragraph, chiefly applies. After a short introductory chapter dealing with the fibres and explanatory of the scheme of the book, the following five sections are each devoted to a study of the composition and characteristics of one of the important groups of dyes, one or two members of each group being used as illustrative of the group. The scheme is well worked out, but sufficient care has not been taken to prevent, what is always a pitfall to students, over generalisation; and instead of giving the student a clear general view of dyeing phenomena, he will probably acquire, by a perfectly logical process, some very erroneous views. For example, chapter vi. is devoted to indigo, chrome yellow, theory of dyeing, and classes of fibres. Now indigo and chrome yellow have absolutely nothing in common, either chemically or in mode of application, and there is not a word of explanation as to the reason for coupling them together until chapter xix. is reached, when it is seen that it is based on the fact that they both form insoluble pigments on the fibre—a purely artificial and altogether insufficient connection.

One would expect, in a book of this type, that the various theories which have been put forward to account for dyeing phenomena would receive considerable attention, but they are not only dismissed in a page and a half, but are quite incorrectly stated.

The experiments detailed in the text are in most cases well chosen, and add greatly to the value of the book, but a student of inquiring mind may well ask why cotton should be dyed with Congo-red in an *alkaline* bath and wool in a *neutral* bath, and the results considered as comparative (Exp. 4). Exp. 12 should certainly be modified. It is highly dangerous to tell a student to pour boiling concentrated sulphuric acid into water, even if the word "caution" is interpolated.

This book is very welcome as an obviously original attempt to teach the general principles of dyeing on novel lines, and most of its shortcomings are explainable by the opening sentence in the preface:—"This book is the result of two years' instruction in dyeing."

W. M. G.

AGRICULTURAL RESEARCH IN ITALY.

Annali della Regia Scuola Superiore di Agricoltura di Portici. 2nd series. Vol. iv. (Portici, 1903.)

This well printed volume contains a series of ten papers contributed by the professors of the Royal Agricultural College of Italy at Portici since the publication of the last report in 1898, together with a general review of the work of the chemical department since its foundation.

The papers are very varied in character; the first is a statistical inquiry into the production of fruit in Italy and other civilised countries; two papers treat of a fungoid disease of maize and of the olive; and of three papers by Prof. Casoria the chief deals with the composition of various saline waters as compared with the rocks they traverse and the deposits of tufa, &c., formed from them. In some of the waters traces of arsenic and nickel are recorded, with titanic acid in measurable quantities.

But the paper which is of most agricultural interest is the record drawn up by Prof. Giglioli, the director, of the experimental work in agricultural chemistry carried out at Portici since 1877. It includes studies in the life of seeds, which were shown to retain their vitality when immersed for years in alcohol or chloroform, so that oxidation, however slow, is prevented and the respiratory process entirely stopped. Another interesting observation was the occurrence of copper in the bat's guano found in certain Calabrian caves, which led to the discovery that copper is a regular constituent and probably possesses some biological function in some insects, from which it passes to the bodies of bats and other insectivorous animals. Experiments on the introduction of plants new to Italian agriculture are recorded, such as the Soja bean, the camphor laurel and the Smyrna fig, over the acclimatisation of which the United States Department of Agriculture has spent so much care.

The field experiments carried out at Suessola include trials of various manurial substances occurring naturally in Italy, such as seaweed, a phosphatic deposit from Otranto, and leucite, a mineral characteristic of the Vesuvian and many of the older lavas of Italy, containing at times as much as 20 per cent. of potash. The dryness of the climate renders the action of merely finely ground mineral manures slow and uncertain, but the phosphatic deposit gave good results when used first for a green crop which was afterwards turned in, while the trials with leucitic earth show promise, and might give better returns if a plant were chosen for experiment more sensitive to potassic manuring than wheat is.

Other investigations deal with the effects of electricity in stimulating crop production, with the action of manganese dioxide as a constituent of manures, and particularly with the cultivation of wheat, the important series of experiments on which have before been noticed in these columns. The author claims that, as at Rothamsted, the plots at Suessola

"demonstrate that a large production of cereals can continue indefinitely provided the land be well cultivated and manured. But while at Rothamsted the growth of wheat alone is possible in each year, in the 'Campania Felice' in the same year crops of wheat and maize forage can be raised. Thus, by the intensity of its production of grain, the fourteen years of experiment at Suessola are equivalent to twenty-eight years in England."

While the above list is by no means exhaustive, it will serve to show the activity of the experimental station at Portici, and the many-sided interests of its director, Prof. Giglioli.

A. D. H.

OUR BOOK SHELF.

La Telegrafia senza Filo. By Augusto Righi and Bernardo Dessau. Pp. vii+518; with 259 woodcuts. (Bologna: Nicola Zanichelli, 1903.)

Prof. Righi has considerable claims to be regarded as the father of practical wireless telegraphy. It was from him that Marconi, as a student at Bologna, derived the knowledge of modern electricity which has enabled him to cross the gap which separates the Old World from the New. The benefits that the university and its professor have conferred on mankind by training a Marconi suggest the question: Should not universities be endowed with exceptional scholarships to assist exceptional men? The advantages of expending 100*l.* annually to help on students of average mediocrity are well known. On the other hand if a university should produce a man with the enterprise of Marconi once in 100 years, the advantage to the community of enabling him to carry on his experiments with the accumulated amount of an annuity that had been left unawarded during the interval cannot be overestimated.

A work on wireless telegraphy, coming from the physical department of the University of Bologna, and bearing Prof. Righi's name, will be read with great interest. The present volume is, however, rather of the nature of a popular treatise intended for readers not starting with any previous knowledge about electricity. Hence the first part, extending over about 110 pages, is taken up with a general account of the principles of electricity and magnetism. The second part deals with electromagnetic waves, the electromagnetic theory of light, and coherers. In the third we have an account of all the different methods of telegraphy, from the earliest attempts at making a telegraphic current flow across a river by conduction, down to a close examination of the Marconi system and the various inventions which have been proposed or patented on parallel lines. In the preparation of this part the authors have evidently made a careful study, not only of the published literature of the subject, but also of the patent specifications both of the "Wireless Telegraphy and Signal Company" and of other inventors, the object evidently being to give an unbiased account of what Marconi actually discovered, and what he derived from other workers in the same field. The fourth part deals with the systems of wireless telegraphy and telephony depending on the use either of ordinary light or ultra-violet rays combined with a photo-voltaic receiver. In a brief appendix, M. Dessau deals with the recent experiments in long distance "Marconigraphy," and gives illustrations of the Poldhu station and the arrangement of the antennæ on ships. This appendix contains several statements of interest concerning the effect of solar radiation on the transmission of signals, the relative merits of the coherer and the magnetic detector (the latter being considered superior by Solari), and such matters.

While the book has been specially drawn up for the general reader, there are few physicists who can read

it without learning something new about the history of the series of inventions and discoveries which have culminated in Transatlantic Marconigraphy.

Catalogue of the Collection of Palaearctic Butterflies Formed by the late John Henry Leech. By Richard South, F.E.S. Pp. vi+229; portrait and two coloured plates. (London: Printed by Order of the Trustees of the British Museum, 1902.)

IT is very gratifying to notice how frequently, at the present day, large private collections of objects of natural history, when of real importance, find their final resting-place in the British Museum, or in some other great public collection, where their treasures are available for ever, instead of being dispersed on the death of the owner, and by such dispersion alone, losing a large part of their scientific value, besides the probability of a considerable portion being neglected, and sooner or later lost or destroyed.

Especially is this the case with great special collections, like that brought together by Mr. Leech, at great expense, and with untiring energy and perseverance, from Lapland to Marocco and Algeria, and from thence to Cashmir, and from Cashmir to Japan, including the materials used in the preparation of his great work on the "Butterflies of China, Japan, and Corea," which is likely long to remain the standard authority on the subject. A great part of these collections was formed by Mr. Leech himself in his numerous entomological journeys, while others were procured for him by enterprising collectors like Mr. A. E. Pratt, in almost unknown and unexplored parts of Western China and Thibet. Besides these, Mr. Leech's collection includes (by purchase) the bulk of the collection formed by the late Mr. Henry Pryer, himself the author of the first important separate work published on the butterflies of Japan, which is also noticeable as having been issued in two languages, English and Japanese. On the other hand, there are comparatively few species and specimens from North Africa and Western Siberia.

Mr. Leech also interested himself specially in the variation of species, and purchased a large selection of varieties of European Lepidoptera from the collection of the late Herr Mützell, of Berlin, as well as from other sources; and as the types of new species in Mr. Leech's collection have already been fully illustrated in the works and papers published by Mr. Leech himself during his lifetime, the two plates which illustrate the present memorial volume are devoted to figures of some of the most interesting varieties, chiefly European. Every specimen in the collection is carefully enumerated in the volume before us, the sex and exact locality being carefully indicated, and all types marked.

Entomologists owe a deep debt of gratitude to Mr. Leech himself, to the liberality of his mother, and to the careful work of his friend and coadjutor, Mr. South, in ensuring the permanent value of this unique collection.

Bacteria in Daily Life. By Mrs. Percy Frankland. Pp. 216. (London: Longmans, Green and Co., 1903.) Price 5s. net.

MRS. FRANKLAND has compiled an interesting, instructive, and accurate account of the modern developments of bacteriology. Such subjects as sewage disposal, the prevention of tuberculosis, micro-organisms in milk, air, and foods, which are of public importance, are fully dealt with, and the modern ideas regarding toxins and antitoxins are briefly discussed. No one nowadays laying claim to a liberal education can dispense with a slight knowledge, at least, of microbes and their actions, and for such this work will prove an adequate text-book. R. T. HEWLETT.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

A New Theory of the Tides of Terrestrial Oceans.

IN NATURE of September 4, 1902 (vol. lxvi. pp. 444–445), Prof. G. H. Darwin makes some criticisms upon a paper of mine to which I should like to reply.

Upon referring to pp. 537 and 624 of the paper criticised, it will be seen that it aims at "rude approximations to the cases found in nature," and at a "partial explanation of the tides." In fact, it bears the title, "Manual of Tides, Part ivA., Outlines of Tidal Theory." If, therefore, the paper establishes, even in a few cases, the principal causes of the tides, connecting the latter with the known tidal forces, it can hardly be regarded as a "failure," even though the approximations are rather rough; for I believe this object has not been heretofore attained for any ocean tide, although statements have elsewhere been made by our critic which might, perhaps, lead some people to think otherwise.[1]

Again, granting for the moment that the theory involved in the paper is erroneous, I should still say that if observed facts can be conveniently grouped by aid of it, a useful purpose will have been subserved. In fact, the mere collection of tidal data which a test of any theory implies is here, as elsewhere, not without value. For instance, if our critic could have had this paper before him while preparing his book on tides, he would not have overlooked Berghaus's invaluable cotidal chart and written "No more recent attempt (than Airy's) has been made to construct such a map."[2]

Prof. Darwin's principal criticisms are three in number:—

(1) He sees no use for the equation of virtual work in ascertaining the times of high water.

(2) He thinks that the deflecting force of the earth's rotation cannot be generally disregarded in a first approximation, which is all that my paper aims at.

(3) He does not believe that ocean basins exist the free periods of which are sufficiently near the tidal period to account for the tides.

(1) Concerning my application of the principle of virtual work, Prof. Darwin is mistaken when he says "Mr. Harris takes the displacements as proportional to the actual displacements per unit time." What is really done is this:—The magnitude of the virtual displacement (δx, say) at any given point of the system is taken to be the same for any given time or hour, but varies from point to point. Since the law of the oscillation of the particles is known, viz. it is simply harmonic in time, and the particles throughout the body are at a given instant in like or opposite phases, the virtual displacement at any given point may always be represented by the maximum value of the actual total displacement at the point (*cf.* rule quoted in criticism). In other words, if we choose to consider the small virtual displacement as identical with a small actual displacement corresponding to a time variation, the implied δt will not be constant for all hours. Hence the virtual displacements at different hours are not simply proportional to the actual displacements *per unit time*. He is evidently mistaken when he says, "Thus all sustaining forces vanish at the instant when the displacement is a maximum." Why should they? Surely they generally vary in magnitude and phase for the various parts of an extended oscillating body. Probably the use of the rule quoted in the criticism and founded upon the principle of virtual work can be most readily seen when it is applied to a binodal canal-like area of uniform cross section, selecting for simplicity, say, the nodes as the points of application of the sustaining forces (*cf.* § 63). The process implied in the rule seems to be correct, and, so far as I see, about as simple as it could

[1] "The Tides," p. 177, lines 2-10. [P. 160, lines 16–23, English edit. I thought that the passage referred to would be understood to refer to the ideal case there under consideration.—G. H. D.]

[2] "The Tides," p. 189, lines 10–12. [P. 171, lines 19–21, English edit. This was an oversight; a reference to Berghaus will be found in the forthcoming article on the tides for the German "Encyclopædia of Mathematics."—G. H. D.]

have been made. Further on the criticism reads, "I fail to see any adequate consideration of the variability of depth, of the absence of synchronism in the disturbing force in the direction of the canal." This "absence of synchronism" is precisely what the criticised equation 308 (or 311) enables us to take account of.

It seems to me that enough has been given in §§ 38, 42, 45, 55, and 63 to show that the variability in depth has not been permanently lost sight of, and also enough to convince one that "areas" as nearly uniform in depth as are many portions of the ocean can, as a first approximation, be treated as bodies having strictly uniform depths.

(2) Of course there are instances where the deflecting force due to the earth's rotation becomes important; for example, most moderately narrow arms of the sea in which the current is swift—such as the English Channel, Irish Channel, and Gulf of Georgia. But if in any of these a large stationary wave actually exists, it is hard to see how the times of its high and low waters near the loops can be seriously affected by this force, and these are the only times which chapters vi. and vii. undertake to determine. Near the nodes, when the current is swift, the deflecting force may, in a canal the width of which is but a moderately small fraction of a half wave-length, cause high water at one end of the nodal line, and at the same time low water at the other. This is true because the narrowness of the body permits its transverse slope to respond at once to the transverse forces. A progressive wave can be so superposed as to diminish or even destroy the range at one end of the nodal line while increasing the range at the other end.

Considering now a broader "area," with one or both of its lateral boundaries wanting, it is hard to see how the transverse motion occasioned by the earth's rotation can seriously interfere with the character of the stationary wave, and especially the time of elongation of the particles; for its effect cannot accumulate and so tend to produce a transverse stationary oscillation. If, on the other hand, a square or rectangular "area" about half a wave-length wide have solid lateral boundaries, it would seem that the deflecting force might, except in the equatorial regions, so alter the mode of oscillation that it could not be ignored even in the first approximation. So far as I know, there is no near approach to this case in any of the "areas" which probably exist (see Fig. 23 of my paper).

Hence, while it is true that the free oscillations in a rotating rectangular sheet of water is an unsolved problem, we see that the critic's remark, "It seems to follow that either Lord Kelvin or Mr. Harris is wrong," if in any sense true, really has very little to do with the case. In a word, taking an oscillating body as a whole, it seems to me that the oscillation, in accordance with a simple mode, can generally be regarded as the fundamental and important thing, and the effect of the earth's rotation a modifying or induced phenomenon.

(3) Now in regard to the improbability "that any large portion of our curiously shaped oceans should possess even approximately the critical free period," several things can be said. In the first place, we are not restricted to *single* half wave-lengths; the rectangular "areas" may run in any direction; the "areas" may be approximately trapezoidal, triangular, or of other forms, their free period may differ perhaps 10 per cent. or more from the period of the forces, and still have their tides greatly augmented by their approach to critical lengths. There are, indeed, portions of the ocean which cannot be covered by any areas the periods of which would be satisfactory, and in which it would be possible for the tidal forces to incite a considerable tide. Upon referring to the map, Fig. 23, it will be seen that one such region exists west of Australia, another south of New Zealand, another east of southern South America, the Arctic Ocean constitutes another. Upon referring to the map of the diurnal tides, Fig. 24, it will be seen that the South Atlantic, the South Pacific, and all of the Arctic Ocean are not regions where we can reasonably expect to find large diurnal tides.

Referring again to Fig. 23, and noting that the ocean is for the most part actually parceled out into areas of considerable width the free periods of which can hardly differ greatly from twelve lunar hours, and are, moreover, so situated that the forces do not approximately destroy one another, as can be seen by applying the rule quoted in the criticism, it may, perhaps, be justifiable to ask how it happens that the times of high and low water at the loops, as determined by this rule, do approximately agree with observed times, unless there is some considerable truth in this "partial explanation of the tides."

Recently I have been working out in considerable detail the tides in the equatorial belt of the Indian Ocean, where it is fair to assume that the effect of the deflecting force must be small. The work goes to show that the theory set forth in the criticised paper is substantially correct. I therefore venture to refer Prof. Darwin to this discussion, which will appear in the March number of the *Monthly Weather Review*.

To avoid needless misunderstanding, it may be added here that I am well aware of the incompleteness of the treatment given in my paper. For instance, mathematicians have not up to this time been able to treat the simple problem of a rectangular "area" the rigid boundary of which consists of only two opposing end walls, although much has been done upon analogous problems relating to the open organ pipe. Even an approximate absolute value of the range of tide (excepting in small deep bodies) has not been attempted in this paper, because its determination would involve the numerical value of frictional resistance, which can be kept in abeyance when we seek only the times of tides in systems which have as free periods very nearly the tidal period. Many deductions and refinements were purposely omitted from my paper—the chief aim being simplicity. I hope eventually to be able to consider more fully matters like these in connection with detailed studies of the tides in various seas.

R. A. HARRIS.

Washington, D.C., March 28.

March Dust from the Soufrière.

SIR W. THISELTON-DYER has kindly forwarded to me a packet of volcanic dust sent to him by Dr. D. Morris, which fell in Barbados last month after an eruption of the Soufrière of St. Vincent, a brief description of which may be of interest. The sample, Dr. Morris states, was collected at Chelston, Bridgetown, on sheets laid out upon the lawn, the material being brought in and weighed every hour, and the fall continuing from 11 a.m. to 5 p.m. on the day of the eruption. It is free from all extraneous matter, and may be regarded as typical of the ash which fell on Barbados. The weight of this is estimated at about 6000 pounds (avoir.) per acre. At an average rate of three tons per acre, this would be equivalent to about 300,000 tons for the whole island.

The dust is of a dull dark brown colour, showing on close examination a minute speckling with a lighter tint. If poured on a piece of white paper and removed in the same way, a distinct warm-brown tint remains, produced by the very finest part of the powder, which is not easily removed. In Dr. Flett's excellent account of the dust which fell in Barbados after the eruption of May 7 (*Quart. Jour. Geol. Soc.*, lviii., 1902, p. 368), it is stated that this was at first brown, then slightly redder, and at last a whitish-grey impalpable powder. A bulk sample of that fall is distinctly greyer than the recent one, and a small one of the fall of 1812, in my possession, is a rather pale grey with a slight brown tinge. The new sample under the microscope differs only in detail from that described by Dr. Flett. The fragments, as a rule, do not exceed 0·01 inch, and are thus very slightly smaller than some in the May eruption; from 0·06 to 0·08 is a rather common size, and there is a fair amount of exceedingly minute dust. The principal minerals are the same, plagioclastic felspar, hypersthene, and a green augite, but in the first steam cavities are now more abundant than glass enclosures, and I think brown glass is more often adherent, but to make certain of this point requires a fuller examination than I can give for the next few days.

T. G. BONNEY.

The Lyrid Meteors.

THE Lyrid meteors excite an interest that might be regarded as quite disproportionate to their numerical importance. They are a very rare shower, and even when considered by experienced observers as unusually abundant, they seldom appear at a higher rate than about twenty per hour.

During the past century the Lyrids have been subjected to pretty close observation. The star shower seen in America on the morning of April 20, 1803—just 100 years ago—seems to have far excelled in brilliancy its Lyrid successors, though a display witnessed, it is supposed, in 1860 in the equatorial regions of Africa is described as having rivalled in splendour the November meteor-shower of 1866. Shooting stars were seen in unusual numbers in America on April 20, 1838, and Prof. Forshey observed a Lyrid display in Louisiana on the night of April 18, 1841, when he counted sixty meteors in $2\frac{1}{2}$ hours, which gives a mean rate of twenty-four per hour for one observer. On the morning of April 21, 1863, these meteors were reckoned by an English observer as appearing at the rate of forty per hour. On the night of April 18, 1876, a party of American students casually noticed that shooting stars were unusually numerous during the hours 10 to 12. Lyrid meteors were also conspicuous on the night of April 20, 1874. Mr. Denning has recorded important appearances of Lyrid meteors in 1882 and 1884, especially in the latter year on the night of April 19. The same observer has also stated that the Lyrid radiant was unusually active in 1893 and 1901, in the former on the nights of April 20 and 21, and in the latter on that of April 21. The foregoing are the most important displays on record since April 20, 1803. Periods of somewhat different lengths have been proposed with respect to the Lyrid showers, but the true period seems to be one which overlaps, and consists of nineteen years. Thus, from 1803 to 1860, we have exactly three periods of nineteen years, and from 1803 to 1841, two periods of the same length. Again, thirty-eight years, or twice nineteen years, separate the showers of 1838 and 1876. The nineteen-year period also connects the displays of 1863 and 1882, of 1874 and 1893, and of 1882 and 1901. This nineteen-year cycle is specially interesting, as it is completed at the Lyrid epoch of the present year, reckoning from the somewhat important display of April 19, 1884. A calculation made by the writer indicates that the maximum in 1903 is on April 19, 10h. 30m. G.M.T. The Lyrid radiant ought therefore to be found active in the early part of the night of April 19, probably from the hours 9 to 12. There is no prospect of Lyrids being numerous on the nights of April 20 and 21.

JOHN R. HENRY.

UNLIKE the August Perseids, the Lyrid meteor-stream, like those of the Quadrantids, Orionids and Geminids in January, October and December, seldom exhibits an abundant shooting-star display, more nearly resembling in that respect the Leonid and Bielid meteor-systems than the stream of August Perseids, its materials appearing to be still collected in one or more dense clusters in its orbit. Its brightest as well as its ordinary apparitions are also, like those of the Leonids, of remarkably short duration, so as to be very liable to escape observation unless splendid enough to arrest attention at some observing station on the globe. The great shower seen in America on the morning of April 20, 1803, only lasted in full splendour for two hours, from 1h. to 3h. a.m.; and a rather sensational abundance of the Lyrids on the morning of April 21, 1863, was entirely confined to the night of April 20, when 11 meteors, chiefly Lyrids, were seen at Hawkhurst in 45m., and 7 bright and several smaller ones were observed in 30m. at Weston-super-mare, between 11h. and 12h., and in a quarter of an hour after 15h., at Hawkhurst, 11 shooting-star tracks were noted, the meteors falling too rapidly then in all directions to be all recorded; the radiant point obtained from that night's tracks, and from a few Lyrids mapped on April 19 (23 Lyrid paths together, some of which may perhaps really have diverged from other centres), was at $277\frac{1}{2}^{\circ}+34\frac{1}{2}^{\circ}$, close to the position which was first obtained of it " near α Lyræ," by Prof. E. C. Herrick, in America, 24 years earlier, on the morning of April 19, 1839. On the preceding night, of April 19, the hourly rate of meteors from 10h. to 11h. was only ordinary, and on the night of April 22, not a single meteor was seen in an hour by either of two observers who watched the clear sky simultaneously from 11h. 15m. to 12h. 15m. in London and at Hawkhurst for hoped-for accordances.

Records of bright Lyrid showers are therefore of peculiar interest, as they may not improbably represent clusters of meteor-dust along the Lyrid stream, like some which appear to have been noted in the stream of Leonids[1] on the mornings of November 15 and 14, in 1871 and 1872, on November 13, 1879, and on the morning of November 14, 1888, when in a watch of $2\frac{1}{2}$h. until daybreak, at Bristol, Mr. Denning noted the appearance of 17 Leonids, although such strong recurrences of the shower are only rarely seen in the interval of some thirty years between the maximum Leonid displays. But the comet 1861, I., of which the Lyrid shooting-stars are supposed to be the streaming wake of pulverised materials, is one of those which it was pointed out by Prof. G. Forbes in his important paper in the *Observatory*, 1888, on the probable existence of an ultra-Neptunian planet, may presumably have been captured by such a planet, and would thus be moving now with long periodic time in a very long elliptic orbit; and this would seem to be a rather serious objection to the short period of 19 years assigned in Mr. Henry's letter to the meteor, unless it should be really true, which seems hardly probable, that the meteors and the wake of dust-materials of the comet are only accidentally in extremely near agreement in their radiant points, and may yet not be actually associated together with each other in a common orbit.

In its two last returns in 1901 and 1902, the Lyrid shower was very distinctly observed to attain its greatest brightness on the night of April 21, and as this retardation of a day from its usual date of April 20 accords like the present similar retardation of the January, August, October and December showers with the postponement of all annual astronomical events by one day, since February, 1900, from the omission at the end of that month of the usual four-yearly leap-year day, attention should certainly, in the reasonable expectation of its fixity, be directed again to the night of April 21, in the approaching Lyrid period, as well as to that of April 19, which the very interestingly detailed evidence presented in Mr. John R. Henry's letter shows also to be one on which an unusually bright display of the April Lyrids may perhaps be expected.

A. S. HERSCHEL.

Observatory House, Slough, April 15.

Mendel's Principles of Heredity in Mice.

I APPRECIATE Prof. Weldon's reluctance to defend his position in a short letter, and I look forward with peculiar interest to the number of *Biometrika* where I gather this task will be undertaken.

Though deferring a reply on the simple matter of the eye-colour in the Oxford mice, Prof. Weldon finds space to ask an " explanation " of two over-lying complexities. To debate these finer points with one who doubts the Mendelian nature of the phenomena taken as a whole is like discussing the perturbations of Uranus with a philosopher who denies that the planets have orbits. Still, at the risk of diverting attention from the main issue, I will suggest how these complications may be regarded—scarcely " explained."

(1) The " lilac " mice illustrate that resolution, and partial disintegration, of characters commonly witnessed when a compound colour is crossed with an albino. The statistical value of the "lilacs" and their place in the colour-system can only be determined by further breeding. The *appearance* of " lilacs " or analogous types is what we expect, though their *absence* in the offspring of hybrids × albinos constitutes a certain problem. This and other genuine difficulties call for careful statement and analysis.

(2) The diversity of coats in the first crosses points to heterogeneity among the gametes of one or both " pure " races. The nature of that heterogeneity is the question. Each race may breed true to colour, but the cross-bred offspring of the two is not necessarily uniform. The pigment excreted by heterozygotes may, as I could easily demonstrate, depend on factors (probably determinable) other than the visible colours of the parents, and having an independent distribution amongst their gametes. Also, while we are comprehensively assured that the coloured race was pure, the precise, if as yet uncontrolled, testimony of the records that certain individuals were *not*, seems to have

[1] From a table of principal observations of the Leonids from 1870 to 1896, in a portion of Mr W. F. Denning's admirable review of the whole history of " The Great Meteoric Shower of November" ; the *Observatory*, vol. xx. p. 201, May, 1897.

been overlooked. More elaborate hypotheses may be needed, but not until the simpler have been disproved.

Grantchester, Cambridge, April 10. W. BATESON.

P.S.—A reviewer declares (NATURE, April 9) that the data in this case are "by no means easy of interpretation," on what hypothesis I know not; and that "much of the evidence is *primâ facie* in favour of ancestral inheritance." It is scarcely too much to state that in each set of matings the distribution (1) of pink and dark-eyed, (2) of coloured and albino coats, (3) of "waltzers" and non-waltzers, is in punctilious agreement with Mendelian prediction. The variety of colour in the first cross I have dealt with. Knowing something of the recent history of fancy mice, two kinds of grey in this generation cause me no surprise. In the whole evidence I can find only three real difficulties, all surely of minor importance. One is named in my letter. The second is the occurrence of three dark-eyed *fawn-yellows* in the offspring of first crosses. The third is the scarcity of yellows in the offspring of hybrids × albinos. If the individuality of the parents were declared, two, perhaps all, of these points could be cleared up. I am not acquainted with any other conception of heredity which elucidates any part of the facts.

Experiment to Illustrate Precession and Nutation.

THE following account of a simple experiment may be of interest to some of the readers of NATURE. The common peg-top and tee-totum are commonly referred to as affording a good example of the phenomenon of precession. I do not think that it is generally known that the motion of nutation can be beautifully shown by the same simple means. Sir John Herschel says in his "Outlines of Astronomy" that the motion of precession can be shown by "that amusing toy, the te-to-tum, which, when delicately executed and nicely balanced, becomes an elegant philosophical instrument." If, however, the tee-totum is not perfectly balanced we have realised the conditions for showing nutation also. If the earth were perfectly homogeneous and undisturbed by any outside irregularity, there would be no nutation. In the same way a tee-totum will not exhibit the motion of nutation if it be perfectly balanced. When, however, one side is made heavier than the other we obtain the phenomenon of nutation. The magnitude of the nutation increases with the extra weight. A series of experiments was made by spinning a small clock wheel on its axis. The best way to see the result is to spin the wheel on a white plate which has been smoked. The trace thus obtained may be studied perfectly. In order to get a permanent record, the wheel was made to spin on a piece of clear glass which had been slightly smoked. The record thus obtained may be used as an ordinary negative, and prints obtained on sensitive paper in the ordinary way. With a little care very beautiful and instructive results may be obtained. The little apparatus may also be projected on the screen, and the actual formation of the curve exhibited. H. V. GILL.

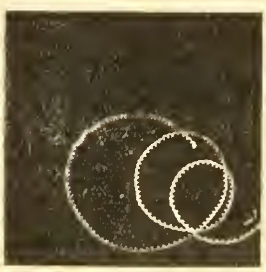


FIG. 1.—Trace made by imperfectly balanced watch wheel spinning on its axis, illustrating precession and nutation.

Clongoweswood College, Sallins, Co. Kildare.

Distribution of Pithophora.

IN October last, I found an old-established paddy-field near Tanabe, the bottom of which, to the extent of several tens of feet every way, was luxuriantly grown with the *Pithophora Oedogonia*, Wittrock, var. *Vaucherioides*, Wolle, with resting spores yet incompletely formed. The locality is some sixty miles south of Wakayama Shi, where I had gathered the same with full spores, October, 1901 (see NATURE, vol. lxvi, pp. 270, 296). The occurrences of the alga in such distant places seem to prove that it is indigenous to Japan. The Floridan specimens I collected in 1891–92 were with spores mature in the months of June and July.

KUMAGUSU MINAKATA.

Mount Nachi, Kii, Japan, March 10.

PEDIGREES.

THE trouble of compiling pedigrees and their unmanageable size led me to devise a method of recording relationships in a form suitable to my own particular wants. As it promises to answer exceedingly well, and to be of more extended utility, I venture to publish it.

The system of relationships between those who live or have lived in a long-established community is wide in extent, of indefinite depth, and interlaced in all directions. The problem is how to arrange its records so that when any individual is selected as a point of departure, it shall be easy to trace his relationships in every direction, whether ascending, descending, or collateral, so far as materials exist. The representation of such a system is wholly beyond the powers of a chart, but its object can be attained by breaking it up into what will be called "Family Groups," each of which slightly overlaps those with which it is immediately connected. A family group, in the sense used here, consists of (1) a parental couple, (2) all their sons and daughters, (3) the wives and husbands of them. Their names are supposed to be written on one page of a register, and the group, as a whole, to be defined by the No. of that page. The group is also defined and indexed under the joined surnames of the parental couple. I subjoin three specimen groups, but in a much abbreviated form for the sake of compactness,

Family Groups.

John Gore.		16 Feb.	31	101
Amy Myers.		24 Mar.	43	
Fred. Gore ..	101	Mary Drew ..	144	205
George Gore ...	101	Jane Boyle	136	211
Ellen Gore	101	John Piers	105	237
Susan Gore	101	*Unmar.*	—	—
Steph. Gore . ..	101	*Unmar.*	—	—
Fanny Gore	101	Harry Pitt	163	223

George Drew.		14 Jan.	51	144
Eliz. Patten.		3 April.	62	
Harry Drew	144	Rose Spry ...	123	315
Mary Drew ..	144	1. Fred. Gore .	101	328
,, ,,	144	2. George Lewis	165	340

Fred. Gore.		26 Nov.	101	205
Mary Drew.		4 Oct.	144	
Frank Gore .	205	Anne Fox	218	340
Amy Gore .	205	James Moss ...	265	344
Anne Gore	205	*Unmar.*	—	—
Alex. Gore ..	205	Eva Sully	241	370
Rose Gore	205	Steph. Bell ...	270	315

only half a line being allotted to each individual. In reality, a short paragraph of full-length lines would be used, to admit of the entry of long names, and of such details as are commonly inserted in pedigrees. Taking group 205 as our subject for explanation, it will be observed that each of the five members of the fraternity—Frank, Amy, Anne, Alex. and Rose—bear the same register No. of 205, which defines that group. The justification for indexing them in the same group lies in the solidarity of each fraternity,

all its members having the same parents, grandparents, uncles and aunts, and every other ascending or collateral relationship. It is not strictly so as regards descent, because the children of each brother or sister are nephews or nieces to all the others, but this material exception leads practically to no confusion. A fraternity is, therefore, treated as a compound unit, the individuals who form it being distinguished by their several names. Thus Rose Gore, 205, serves as a complete definition of her. The husbands and wives of the fraternity 205 belong severally to fraternities of their own, the numbers of which are attached to their names; thus the husband of Rose Gore, 205, is Stephen Bell, 270. Her father, Fred Gore, belongs to group 101. and her mother, Mary Drew, to group 144. Both of these latter groups are printed here. Each parental couple heads a new group; thus, Fred. Gore, 101, and Mary Drew, 144, combine to form the head of the new group 205. Similarly, Rose Gore, 205, and Stephen Bell, 270, form that of the new group 315. It must be clearly understood that there is no relation between these numbers as such; they indicate no more than the No. of the page on which the new group happens to be entered. Every individual who is married and has children is entered in at least three different family groups, (1) that of his own fraternity, (2) in that of his wife, (3) in that in which he appears as one of the parental couple. If he marries a second time and has children, his name will appear as a parent in a fourth group, thus Mary Drew, 144, is entered as mother in each of the two groups 328 and 340. It will be noticed that the day and month of birth is added to the name of each parent. This is a useful distinction in some Welsh and Scotch pedigrees where the same names repeatedly occur. It is a distinction of great efficacy, as the chance against a namesake having the same birthday is about 365 to 1. If so, the chance against a namesake *couple* having the same birthdays as the couple in question would be 365×365, or upwards of 130,000, to 1.

Employment of the Tables.—Let us follow out the relationships of Frank Gore, 205, as far as these three tables permit. His father, as we know, is Fred. Gore, 101. Referring to 101, we see that his paternal grandfather and grandmother are John Gore, 31, and Amy Myers, 43, respectively, so we should have to refer to the family groups 31 and 43, which are not given here, to know more about them and their own near relations. We see that Frank Gore, 205, has two paternal uncles, George and Stephen; George married Jane Boyle, 136, and has the children described in 211; Stephen is unmarried. Frank has also three paternal aunts, Ellen, Susan and Fanny; the second unmarried, Ellen married to John Piers, who has children in 237, and Fanny married to Harry Pitt, 163, who has children in 223. Jane Boyle's immediate relations are to be found in 136, those of John Piers in 237, and those of Harry Pitt in 163. The fraternities 211, 237 and 223 exhaust the list of Frank Gore's first cousins on the paternal side. The group 144 enables an equally complete analysis to be made on the maternal side. We can proceed in this way step by step as far as material exists. Intermarriages create no difficulty. The extreme confusion that arises from the ambiguous words of uncle, aunt, cousin, &c., is wholly eliminated by this method of working, also that which is due to half-blood relationships.

It should be remarked that information is usually to be obtained with ease concerning any particular family group, because a knowledge of its details is shared by many persons. The father and the mother each know, of course, the names of their own children, and of those to whom they are married, in all but very exceptional cases. Similarly each brother and sister knows the full Christian name of his father and mother, and the mother's maiden name also, as well as the names and order of birth of his or her own brothers and sisters. This same knowledge is usually shared by the brothers- and sisters-in-law.

This method of fraternal unities and of family groups may be applicable to experiments in breeding animals and plants, but with modification of detail appropriate to each case. Where the breeding season is brief, the birthday would be of small distinctive value, even when the year of birth is added to it. FRANCIS GALTON.

STANDARDISATION.[1]

THE first two publications referred to below are the first direct outcome of the work of the Engineering Standards Committee; the third is very intimately connected with that work.

The committee was appointed nearly two years ago, and owes its origin to the councils of the five great technical engineering societies acting on the suggestion of the council of the Institution of Mechanical Engineers.

Its existence is a symptom of the times, an indication of the fact that English engineers have grasped the importance of scientific cooperation and the necessity for organisation on a scientific basis.

The main committee consists of fourteen representatives of the five societies, leaders in the various engineering industries which they represent, and these have called to their assistance seven or eight sectional committees and a number of subcommittees to advise on special points. Representatives of the technical Government departments serve on many of these, and the movement has the support of the leading manufacturers. The work has grown and is growing; investigations of various kinds are needed to elucidate doubtful points before the committees can finally report; some of these are in progress at present at the National Physical Laboratory and elsewhere, and many men are working in a manner unknown before to strengthen English industry and to enable it to compete on favourable terms with foreign rivals.

Some months since it was announced that the committee dealing with steel structures was prepared to reduce considerably the number of sections to be rolled as a regular thing and stocked by the manufacturers, and the list it has proposed has just been issued. The committee is to be congratulated on its work. In all cases there has been great reduction and simplification, a result which will lessen the cost of production by reducing the number of rolls required, and will quicken the rate of supply by permitting stocks to be kept on hand. Thus it appeared that some forty-nine or fifty sizes of beams were in common use; these have been reduced to thirty; while for channels, in place of sixty-three, there are to be twenty-seven sizes rolled.

The recommendations as to rails have not yet been finally issued; at present there are seventy-three different sizes of tramway rails rolled; it is hoped to reduce these to five.

Messrs. Dorman Long and Co.'s new list referred to above is based on these standard sizes, of which a large supply is kept in stock at their various depots. The list gives, in addition to the dimensions and weight of the beams, various other data of importance, *e.g.* the moments of inertia about certain axes, and the safe distributed load for spans of various lengths.

[1] British Standard Sections issued by the Engineering Standards Committee.
British Standard Beams. (Dorman Long and Co.
Standard Sizes of Conductors. (Cable Makers' Association.

But these lists, valuable as they are, contain but a very small portion of the results we may hope for. The committees on sections used in ship building, on locomotives, and on electrical plant, each appeal to an enormous industry, and in each of these there is much that can be standardised. Take, for example, the various sizes and speeds used in dynamos and motors, the numerous voltages in electric light and power systems, and the varying frequencies of alternators. The committee on electrical plant, of which Sir Wm. Preece is chairman, has subcommittees on electric generators, motors, and transformers under Colonel Crompton, on telegraphs and telephones under Mr. Gavey, and on cables under Mr. R. K. Gray.

Both in America and in Germany committees on the standardisation of electric plant have reported within the last few years, and the value of their work is generally recognised; their results will be of distinct service to the English committee when the time comes to frame its report. Meanwhile one important industry has already acted. The lists of standard sizes issued by the Cable Makers' Association carry out in an admirable manner the principle of standardisation.

There is no doubt that the belief expressed by the association that the adoption of these standards will act equally for the benefit both of the purchaser and of the manufacturer is well founded, and it is greatly to be hoped that they may be adopted.

Standardisation, of course, has its dangers; it may tend to crystallise the form of products, and thus to delay progress. These possible dangers are clearly before the minds of the practical men who form these various committees, and will have due consideration in their reports. Meanwhile, we can only repeat that the need for standardisation is enormous, and its advantages immense.

The announcement contained in the papers recently that a vote of 3000*l*. for the work of the committee is to be included in the estimates for 1903–1904 is a gratifying recognition of the value of its work, and Sir Francis Hopwood expresses the view of all qualified to judge when in his letter intimating this grant he writes:—

"The Board of Trade desire me to state that they regard the work undertaken by the committee, including as it does the preparation of standard specifications for engineering works, and of standard sections of rolled iron and steel, together with the standardisation of parts of locomotives and electrical appliances, as tending to reduce both the cost of production and the time occupied in completion, and as being of the highest value to the country at large."

But, as has been already said, the work yet accomplished is but a small fraction of that which remains to be done, and the further reports of the committee will be eagerly expected by engineers.

ITALIAN VISIT OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Institution of Electrical Engineers has just completed a visit to northern Italy to inspect the chief works of engineering interest. The Institution has made several continental visits of this kind during the last few years, and although it is difficult to gather much in the way of detail on such occasions, it nevertheless seems to be helpful to many to get some general ideas of what our neighbours are doing, and at the same time to get the advantage of a little pleasure from the scenery which, in this case, is among the most beautiful to be found in Europe.

Probably the piece of work that was looked forward to with the greatest interest was the electric railway from Lecco to Sondrio and Chiavenna on the Ganz system, as it forms a bold experiment, and is the first of its kind. The total length is sixty-three miles. The electric energy is generated by three-phase machines at 20,000 volts, and is transformed down at nine points along the line to 3000 volts, this comparatively high voltage being taken direct by the trolley to the motors. Voltage as high as this necessitates many unusual precautions of an interesting kind; for example, the rheostats and switches are worked pneumatically, so that the driver does not operate direct any apparatus subject to high tension. The method of coupling up the motors is also interesting from its novelty. Instead of working the motors in the usual way, they are divided into high and low tension motors. The high pressure current is taken only to the stators of the high tension motors; the rotors of these machines are used to supply low tension three-phase current to the stators of the low tension motors. The low tension motors are thus supplied with current at a lower frequency than the main current. This "cascade" method of working is continued until half speed is attained, when the low tension motors are cut out and full speed is reached on the high tension motors alone.

The recent arbitration, in which it was decided not to use the Ganz system for the Metropolitan Railway, is still fresh in the minds of most people. Although this system does not seem so suitable for cases in which the acceleration at starting and the speed must be high, it should certainly afford a cheap method of working long lines not having much traffic. As seen at Valtellina, the ease and smoothness of working were all that could be desired.

On looking at the boldness of the experiment, one cannot help being struck by the difference between Italy and our own country in taking up a thing of this kind. But it must not be forgotten that one of our greatest sources of wealth tends to keep us from using electrical methods. If the price of coal were double its present value, which is the sort of price which holds in Italy, then the coal bill would be a larger proportion of the whole cost, and it would be more worth while to attempt a saving.

The usual form of electric traction by means of direct current at 650 volts, transformed from high tension three-phase, was seen on the line from Milan to Gallarate and Porto Ceresio. This line is forty-seven miles in length, and also differs from that to Valtellina in having much heavier traffic and higher speeds, and in being partly worked by steam. It is therefore of great interest to those who are at present considering the electrical working of our main lines.

Overhead lines are, of course, a feature of every long-distance transmission. It does not seem to be generally realised how much we have to pay for putting all conductors underground, though this subject will no doubt come forward more prominently when our large power distribution companies get really to work. One disadvantage of overhead lines is that they are subject to lightning discharges. Many protecting devices have been tried, and a particularly interesting one was seen at the Monbegno generating station on the Valtellina line. It consisted of jets of water forming a permanent earth, but of such a resistance that the loss does not amount to more than about 2 kilowatts. The action is said to be very satisfactory.

At Milan several large works were visited, and also the Royal Technical Institute. The latter is not very large, but is usefully equipped. The room for electrical measurements contains instruments in one group for measuring all the usual quantities over a wide range. In the motor and dynamo testing room the

most interesting piece of apparatus was a three-phase motor carried on a suspended bed, so that the torque could be measured, and driving a dynamo coupled direct to the end of the shaft. The other end of the motor spindle was fitted with a disc divided into black and white sectors, so that the slip of the rotor when driving the dynamo at various loads could be directly observed by the stroboscopic effect produced on illuminating the disc with an incandescent lamp on the mains supplying the current. There are also two other small motor generators, and a motor of about three horse-power fitted with an electromagnetic brake disc.

The photometry room contains a Lummer Brodhun photometer with Hefner Alteneck standard for general photometric work. For variations of light in arc lamps, as shown by the illumination in a plane, a photometer due to Prof. Rousseau is used. This consists of a vertical disc with two radial arms carrying mirrors. The arc is placed in the axis on one side of the disc, and the light is reflected by the mirrors on to the other side, where it gives two shadows of an axial rod. One of the arms and the mirror on it being conveniently clamped, the other arm is moved from point to point, and the mirror on it is adjusted until the shadows are equally intense as in a Rumford photometer. The variation of the light is thus found in terms of the fixed direction, and the absolute value of

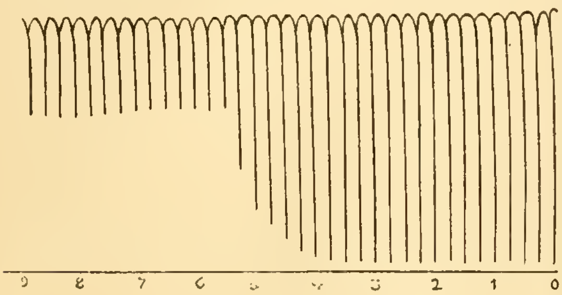


FIG. 1.—Graphic record of cement test.

this is found, if desired, by means of a Weber photometer.

The engineering laboratories contain a small experimental steam engine and other plant, including a dynamo driven by a high speed steam engine, a gas engine and pumps. Complete efficiency tests are carried out, of which the students are required to write detailed reports. There is also a 100 ton testing machine. This is worked hydraulically, the town water being received at three atmospheres and transformed to 250 atmospheres. There is also a fine adjustment worked electrically, the forward or reverse motion being put on by an electromagnetic coupling.

At the time of the visit tests were being made on the deflection of cement beams used for arching in floor work. They were being loaded up to the point of fracture.

One of the most interesting pieces of apparatus was that used for testing the setting qualities of Portland cement. For testing, the cement is made up in a mould about 3 inches in diameter and $1\frac{1}{2}$ inches thick. This is rotated slowly about its axis by clockwork, which allows a needle weighted with 300 grammes to fall once every quarter of an hour. If the cement is soft, it pierces the cement to the bottom, but as hardening sets in the needle does not pierce the full thickness, until finally it fails to make any impression. The result is automatically recorded as shown in the figure (Fig. 1), in which the ordinates represent travel of the needle, and abscissæ time. It will be noticed that the effect of hardening in this example appeared after about 4 hours, and the needle failed to make an impression after $5\frac{1}{2}$ hours.

The Italian visit made it evident that not only was beautiful scenery to be enjoyed, but that Italy is at present the home of some of the most interesting and original engineering works.

NOTES.

THE Royal Society's Croonian lecture will be delivered on Thursday, April 30, by Prof. Klement A. Timirjazev, upon "The Cosmical Function of the Green Plant."

A CORRESPONDENT informs us that on April 1 Dr. G. V. Neumayer left the Deutsche Seewarte at Hamburg, of which he had been director since 1876.

A REUTER message from St. Petersburg announces that the Imperial Russian Geographical Society will send a scientific expedition into Mesopotamia during the year. The expedition will be under the leadership of M. Kaznakoff, and will include among its members M. Alferaki, zoologist, and M. Tolmatcheff, geologist.

THE President of the Board of Agriculture has appointed a Departmental Committee to investigate experimentally and to inquire into and report upon :—(1) The composition and essential constituents of efficient dips and other preparations for the treatment and dressing of sheep, and their effect upon the animal treated or dressed, and upon the parasites and other organisms for the destruction of which they are used ; (2) the methods in which such dips and other preparations should be employed, and the appliances and facilities requisite for the purpose ; (3) the times and intervals at which sheep should be treated or dressed, regard being had (*a*) to the life-history and characteristics of the sheep-scab Acarus and of the other parasites and organisms of sheep which require external treatment, and (*b*) to the practical conditions under which sheep-farming is carried on in various parts of the United Kingdom. The committee includes Dr. T. E. Thorpe, C.B., F.R.S., Prof. J. R. Campbell, Mr. A. C. Cope, Mr. M. Hedley, and Dr. W. Somerville. Prof. Winter will act as secretary to the committee.

MR. W. DE FONVIELLE writes to say that for the first time since the Eiffel Tower was open to the public in 1889, it was used for astronomical purposes on the occasion of the recent lunar eclipse (April 11–12), when a number of members of the Société astronomique de France spent some hours making observations on the terrace of the monument at an altitude of about 870 feet above the Seine.

A REUTER telegram from Colon states that slight shocks of earthquake occurred there and at Panama on the morning of April 17.

THE *Athenaeum* announces the death, in his seventy-third year, of Prof. Laborde, of the Paris School of Anthropology, and of M. E. Duporcq, the secretary of the French Mathematical Society, at the early age of thirty-one.

A GENERAL agreement has been arrived at between Marconi's Wireless Telegraph Company and a group of Danish financiers in Copenhagen for the establishment of a wireless system between Iceland and the north of Scotland.

THE following announcement appeared in Saturday's *Times* (April 18) :—" Owing to the breakdown of a subsidiary device employed in connection with one of the telegraph stations established by the Marconi Company for

Transatlantic wireless telegraphy, the service of telegrams to the *Times* by Marconigraph from America is temporarily interrupted. The company state that the disablement of the apparatus is purely of a mechanical nature, and that the necessary repairs will shortly be completed."

A Reuter message from Rome states that the Marquis Luigi di Solari has submitted to Mr. Marconi, on behalf of the Italian Government, a convention for the establishment on the coast and on the islands off the Italian coast of a system of twelve Marconi radio-telegraph stations of an average range of 300 kilometres. Some of these stations are to be complete before the end of the present year, and the others within the first half of 1904. Two of these twelve stations will be those already established at Punta di Vela and Montemario, which will, however, be strengthened. These will be exclusively reserved for military use; others, to be used for both military and commercial purposes, will be established at Capo di Leuca, near Gaeta, at Elba, and at Asinara.

Prof. Fleming, in a long letter to the *Times* of April 14, describes in detail the experiments on syntony which he recently carried out at Poldhu. The letter does not embody much more information than was given in Prof. Fleming's Society of Arts lectures, which we have already summarised (p. 518). That Prof. Fleming himself was thoroughly satisfied with the results may be gathered from the following paragraph:—"This experiment," he writes, "which was very carefully carried out with all precautions necessary to prevent collusion between the assistants concerned, and to secure that the conditions were such as will exist in practice, appears to me to afford a complete demonstration of the truth of Mr. Marconi's statement that the waves sent out from his power stations do not, and will not, interfere with the reception of messages from his apparatus as placed on board ship." It is very satisfactory to have this assurance, but even without it one could not help feeling that the Marconi Co. would not have pushed ahead so fast with the Transatlantic signalling if by so doing they were ruining the intermarine communication which they have established.

We are informed that it is the American Geographical Society, and not the U.S. National Geographic Society, which has awarded the Cullum medal to the Duke of the Abruzzi for his ascent of Mount St. Elias and his Arctic explorations.

Reuter's Athens correspondent has announced that the Italian Archæological Mission has discovered, near Herakleion, in Crete, on the site of ancient Phaestos, a magnificent palace and various objects of exceptional interest analogous to those found at Knossos.

M. Lippmann is to succeed M. Poincaré as president of the French Astronomical Society next May. M. Janssen has been elected *président d'honneur*. The Society's prize has been awarded to M. Charlois for the discovery of a large number of minor planets, and the Jannsen prize to M. Giacobini for the discovery of seven comets.

The International Conference on Deep-sea Investigation was opened at Wiesbaden on April 16, under the presidency of the Prince of Monaco, representatives of geography being present from England, Germany, France, Norway and Sweden. The committee appointed by the Geographical Congress which met in 1899 presented a report on questions connected with oceanic research at great depths.

In a letter addressed to Sir Alfred Jones by the expedition sent by the Liverpool School of Tropical Medicine to investigate the newly-discovered parasite of human trypanosomiasis, it is stated that a number of natives had been examined, but that the parasite had not been found in any. In two horses, however, a trypanosome was found, and it is stated that another horse had been infected with the human trypanosome. In a common species of horse fly that had fed on this last horse, numerous trypanosomes were found in the stomach. The letter was sent from McCarthy Island, 150 miles in the interior of Gambia.

We learn from the *Times* that Dr. Jonathan Hutchinson, F.R.S., has now returned from his tour in India and Ceylon, in which countries he has been studying the ætiology of leprosy. Dr. Hutchinson has always held that leprosy is connected in some way with the eating of fish, and it was to test the truth of this hypothesis that he has made this tour, and, shortly before, one to South Africa. Dr. Hutchinson, as the result of his inquiries, believes that only in a very small minority of cases of leprosy can a fish diet be excluded. Its great prevalence is almost always in or near a fishing district. Dr. Hutchinson's general conclusion is that, as regards leprosy in India, there are no facts which controvert or render untenable the fish hypothesis, and that there are some which afford to it a support which he considers to be unassailable.

News has been received at Berlin, from Australia, of the German Antarctic expedition under Dr. Erich von Drygalski, which left for the South Polar regions in 1901. The steamer *Stassfurt*, of the German Australian Steamship Company, reached Sydney on April 17 with four members of the expedition, who were landed at Kerguelen Island from the expedition ship *Gauss* for the purpose of making a year's magnetic and meteorological observations, which were necessary for the main expedition in order to confirm the observations taken further south. One of the observing party, Dr. Enzensperger, died of beri beri on the island on February 2, and Dr. Werth, geologist, who is among those landed from the *Stassfurt*, was also taken seriously ill. He is now better, but will be detained in hospital. The remaining three explorers are well.

Dr. Hans Reusch describes in *Naturen* for March the only known natural fountain in Norway, locally known as Bubbelen. It lies in a remote and little-known valley, Bognelvdal, 10 kilometres south of Sopnaes, at the head of Langfjord, a branch of Altenfjord, Lapland, 70° N. 22° E. It is formed by a stream which itself is fed by the overflow of a river, and has flowed underground through the limestone for three kilometres. The fountain rises from a basin six metres deep in a column of water which varies in size according to the season, and flows away as a stream, which even in dry weather is seven metres broad and two metres deep.

The Naples Academy of Physical and Mathematical Sciences offers a prize of 1000 lire to the author of the best memoir on the theory of the invariants of the ternary biquadratic form, preferably in connection with the conditions for splitting into lower form. The papers may be written in Italian, Latin, or French, and must be sent in on or before June 30, 1904. In addition prizes are offered in connection with the legacy of Prof. Luigi Sementini, who in 1847 left a sum of 150 ducats per annum "to distribute it as a prize for three memoirs on applied chemistry which they shall judge the best, or to award it as a prize to the author of one single memoir containing great utility, or finally to give it as a life pension to the author of a classical discovery useful to sick mankind." Competitors for this prize are invited to send in their applications, accompanied by manuscript or printed papers, not later than December 31, 1903.

A note in the *Times* refers to a report by Mr. Neville-Rolfe, British Consul in Naples, in which he mentions the widespread interest now being taken in Italy in the question of reafforesting the country. In 1877 about four millions of acres were withdrawn from the operation of the old forest laws, as well as about one million acres in Sicily and Sardinia. The consequence was a reckless destruction of forests, and now it is generally admitted that the State must step in to save those that are left and to aid in replanting. The question now being discussed is what trees are to be used for the latter purpose.

The increase of temperature referred to in our last issue, caused by the advance of a small cyclonic disturbance on Tuesday, April 14, was of short duration; by the morning of April 15 the centre of the disturbance had reached the Dutch coasts, and in its rear the winds had become northerly; the day temperatures again became abnormally low. Severe frosts on the ground occurred at night, which, up to Tuesday last, have been continuous at Greenwich for ten days; the mean of the terrestrial radiation temperatures there for the week ending April 20 was 20°·8, being 10° lower than the mean for the corresponding period last year. On the morning of April 18 a temperature of 24° was registered at Newton Reigny and Dungeness. Such a low temperature had not been registered in the neighbourhood of the latter station, in April, in the values for thirty years published by the Meteorological Office.

A violent snowstorm passed over Berlin on Sunday night, and the snow lay several inches deep in the streets on the following morning, April 20. The Berlin correspondent of the *Times* states that more than forty trees were blown down in the Thiergarten. The Royal Park at Potsdam has suffered very severely, and many valuable trees planted in the time of Frederick the Great have been uprooted. Telegraphic communication with Sweden and Russia was interrupted, and many of the inland wires to the eastward of Berlin have broken down. The trains from the provinces of Posen, Silesia, and East and West Prussia arrived at Berlin many hours late on Monday, and on many sections of the railways in the eastern half of the Kingdom of Prussia traffic was completely interrupted. In Denmark the gale was even more severe. Trains could not proceed from Copenhagen in any direction, and telegraphic and telephonic communication was also interrupted. On Monday the Danish capital was, in fact, almost entirely cut off from communication with her immediate environs and with other countries. Snow reached a depth of four to six feet. Two local trains sent from Copenhagen with snow-ploughs only reached from ten to twenty miles from the capital. A severe snowstorm swept over the whole province of Petrikovo, Russia, on April 21.

We have received the report of the Government Observatory, Bombay, for the year 1902; the director, Mr. N. A. F. Moos, is assisted by a native staff of ten members. The observatory is well equipped with self-recording instruments, and directs its attention chiefly to terrestrial magnetism, meteorology, and seismology, and to some extent to astronomical observations. The work appears to have been carried out with great efficiency; the seismic observations show distinct evidence of sudden increased activity during the year, and it is stated that the records promise to be of considerable value in connection with the relation which probably exists between earthquake phenomena and terrestrial magnetism. Special magnetic observations have been made (at times every twenty seconds) in connection with the international programme decided on during the period of the English and German Antarctic expeditions.

Although the surface wind was from the east, the dust cloud from the eruption of the Soufrière of St. Vincent at 6.30 a.m. on March 22 reached Bridgetown, Barbados, 100 miles to eastward, by 9 a.m., so that its rate of motion was not less than forty miles an hour after having attained an elevation of probably three miles at least above the Soufrière. Its altitude above Barbados was estimated at about 8000 feet, or double the height of the Soufrière. At several points the first fall of dust was observed at 11.15 a.m., it increased until 1.30 p.m., then diminished, and by 5 p.m. it had ceased. In the neighbourhood of Bridgetown the fall was at the rate of about $2\frac{1}{2}$ tons per acre; considerably less at Bathsheba, fourteen miles to the north-east; while at Codrington House, two miles north of the town, it amounted to 6·52 tons per acre. Taking 3 tons per acre as the average would give 300,000 tons for the whole island. The May dust was a very light grey, that of March very dark—almost black, Dr. Spencer describing the March dust cloud as of a deep Prussian blue colour.

The Imperial Department of Agriculture for the West Indies has now published the complete report and statistical information relating to the sugar-cane experiments in the Leeward Islands, Antigua and St. Kitts, in the season 1901–02. Part i., 55 foolscap pages, deals with experiments with varieties of sugar-cane, with an appendix on the chemical selection of sugar-cane. Part ii., 115 pages and six large diagrams, treats of manurial experiments. The general results have already been noticed in these columns.

The London County Council has now issued the complete report upon the examination of the atmosphere of the Central London Railway, carried out by Dr. Clowes and Dr. Andrewes. A short statement of results submitted to the Council has already been described (p. 488). Generally, the amount of carbon dioxide was largest in the air of the carriages, but not, as might have been expected, in the smoking carriages. The highest proportion of carbon dioxide found was 14·7 volumes and the smallest proportion 9·6 volumes in 10,000 volumes of air. The air in the passages leading to and from the stations was generally better than in the lifts—on one occasion as much as 15·2 volumes of carbon dioxide in 10,000 volumes of air were present in a lift; but of all the samples 22 per cent. contained less than twice as much, and 34 per cent. contained less than $2\frac{1}{2}$ times as much carbon dioxide as that found in outside air. Dr. Clowes suggests as a standard that air taken at any point on the railway should not contain more than 8 volumes of carbon dioxide in 10,000 of air. The bacteriological examination of the air by Dr. Andrewes showed micro-organisms to be present in somewhat greater proportion than in the fresh outside air in the ratio of about 13 to 10, the number of organisms being proportional to the concentration of human traffic. The air of the railway does not in its bacterial content compare unfavourably with inhabited rooms generally, and no pathogenic germs were detected.

In the April number of *Climate* Dr. Louis Sambon gives an admirable popular account of malaria, illustrated by a number of original drawings by Signor Terzi. Dr. Harford discusses the physical qualifications necessary for residence or travel in the tropics, and there are other articles upon the "Spread of Yellow Fever," "Surgical Emergencies," and "Sanitary Reform in West Africa."

A SECOND edition has appeared of the "Meteorologia Dinamica," by P. A. Rodrigues de Prada, director of the Vatican Observatory. It is published in Madrid, and deals with atmospheric tides, winds, cyclones, and air currents generally.

MESSRS. HOEPLI, of Milan, have issued the second edition of Ingegnere G. Vacchelli's book on "Le Costruzioni in Calcestruzzo," the first edition of which appeared in 1899. It is one of the Manueli Hoepli, and deals with the properties of concrete, cement, and hydraulic lime, and their uses for building purposes. Special attention is given to the use of cements in the construction of bridges and submerged structures.

IN the *Atti dei Lincei*, xii., 6, Signor G. Guglielmo describes a method of determining the work-measure of the specific heat of water, which resembles the classical experiment of Joule in that the liquid is raised in temperature by agitation, but the liquid is contained in a closed vessel (the calorimeter of Fabre and Silbermann was used) having paddles or blades fixed projecting into the interior, and the agitation is effected by rotating the vessel alternately in one sense and then in the other.

SOME months ago the French Physical Society commenced the publication of a collection of elementary experiments in physics, and invited the cooperation of the members in describing experiments or details of apparatus which they had found useful, especially for teaching purposes. In a further circular the secretary, M. H. Abraham, states that the first part, dealing with geometry, mechanics, gravitation, hydrostatics and heat, is nearly complete, and the second part, dealing with acoustics, optics and electricity, is already in course of preparation.

THE French Physical Society held its annual exhibition of apparatus in Paris last week. The entrance hall and vestibule were lighted with "heliophone" lamps of the French Incandescent Gas Company, the staircase and ground floor by the French Oxyhydrogen Company, and the entrance hall of the first floor by Nernst lamps. Conferences were held in the Physics Theatre of the Faculty of Sciences on April 16, 17 and 18, at which the following papers were read:—On anomalous propagation of the form of vibrations in the neighbourhood of a focus, by M. G. Sagnac; recent researches in radio-activity, by M. P. Curie; experiments on electric convection, by MM. Crémieu and Pender; and further experiments on electric convection, by M. Vasilesco Karpen.

THE *Bulletin de la Société d'Encouragement* for February 28 contains two papers of interest in connection with the problem of aërial navigation. In the first of these M. Barbet describes the latest experiments by M. Canovetti, of Brescia, on the resistance of the air to moving bodies of various shapes. The method, which has already been described in previous papers, consists in attaching the body under observation to a small trolley (chariot) which descends under gravity, along a wire 380 metres long stretched from the top of the fortifications at Brescia to a point on the plain below, the difference of altitude being 70 metres. By comparing the times of descent with those observed when the resisting body was removed, an estimate was formed of the coefficient of resistance. From experiments with aëroplanes, M. Canovetti found that an aeroplane of 200 square metres, weighing 1000 kilograms, moving at a speed of 16 metres per second, would require 100 horse-power to maintain it in the air, and that under these conditions the problem was impossible; further, that more power was necessary for driving an aëroplane through the air than for propelling an automobile of equal weight on a road. By experiments on the resistance of two circular discs placed one behind the other, M. Canovetti has plotted the form of the cone of air entrained by a moving disc.

IN the second paper Commandant P. Renard discusses the conditions of safety of navigable balloons, and suggests to the Société d'Encouragement a list of seventeen questions which should be put to the inventor of every navigable balloon before offering him official support or assistance. These questions refer to the provision of an adequate secondary gas bag (ballonet), which can be inflated by a sufficiently powerful ventilator driven by an independent motor, the satisfaction of the conditions of longitudinal stability, the avoidance of rigid parts, especially in the neighbourhood of the balloon, the arrangement of the motor and the gas valves in such a way as to minimise the danger of the escaping gases accumulating where they could be set on fire by the motor, the refrigeration of the gases escaping from the motor, the provision of fire extinguishing appliances, and last, but not least, the all-important question, "Are you a good aëronaut, or do you intend to take one with you?"

To the March number of *Petermann's Mitteilungen* Herr Arno Senfft contributes the first part of a paper on the ethnography of the island of Yap, in the Carolines. The botany of the Carolines has been treated by Prof. Volkens in his memoir on "Die Vegetation der Karolinen," and the geology by Dr. Kaiser in a paper published by the German Geological Society in 1902; Herr Senfft's paper is an important contribution towards the complete description of the group.

IN the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, Dr. G. Wegener gives an account of the volcanic eruptions which occurred on Sawaii, in the Samoa islands, in the beginning of November last. There seems to be a good deal of evidence, geological and traditional, to show that volcanic disturbances occurred in the island within comparatively recent times, possibly about 200 years ago. The present activity is particularly interesting, because, after a long period of quiescence, the eruptions have recommenced without any violent display of energy.

FROM the Smithsonian Institution we have received a copy of a paper by Mr. R. S. Bassler on the structure of the extinct bryozoan genus Homotrypa, with descriptions of new species.

IN a recent issue of the *Proceedings* of the Boston Natural History Society (vol. xxxi., No. 1), Mr. M. T. Thomson describes the larva of *Naushonia crangonoides*, a rare shrimp, at present known in the adult condition by one specimen from Naushon Island and a second from Rum Island, both in the neighbourhood of Wood's Hole.

IN describing the best mode of rearing the curious larva of the annelid Polygordius, Prof. W. K. Brooks, in the *Johns Hopkins University Circulars* for March, comments on the circumstance that the adult has not hitherto been taken on the American coast. This he believes to be due to the lack of a sufficiently careful search.

ACCORDING to *Science* of March 27, the American Morphological Society and the zoologists of the central and western States have combined forces, under the title of the American Society of Zoologists, of which there is to be a western and an eastern branch. It is expected that the new body will meet once in three years, the meetings to be held alternately in the territories of the two branches.

In reference to an idea that beavers survived in Yorkshire until a very late period, Mr. T. Sheppard, in the *Naturalist* for April, explains that the item "bever-heads" occasionally met with in old parish accounts refers to the otter. He adds, however, that remains of the beaver have been found near Beverley, as well as in other parts of the county.

We have received vol. ii., part xiv., and vol. iii., parts i. and ii., of the *Annals* of the South African Museum. In the first of these Mr. S. Thor, of Christiania, treats of the South African water-mites (Hydrachnidæ), recording a number of new forms. In the second Dr. W. F. Purcell describes some new generic and specific types of Solpugidæ, and likewise gives an account of a collection of Arachnida recently made in one district of Cape Colony; while in the third Mr. Distant continues his notes on Rhynchota.

At Tonybee Hall to-morrow, April 24, a course of five lectures on "The How and the Why of Decoration" will be commenced by Dr. A. C. Haddon, F.R.S. The lectures will deal with the origins of designs, art and handicraft, art as a means of instruction, art and religion, and the decorative art of British New Guinea as an example of method.

Messrs. Macmillan and Co., Ltd., have added Kingsley's "Water-Babies" to their Illustrated Pocket Classics. The illustrations of Linley Sambourne are included, and it would be difficult to imagine a more attractive edition of this instructive fairy tale.

The drawings contained in the three volumes of Mr. W. S. Taggart's "Cotton Spinning" have been published in a separate book, under the title "Cotton Machinery Sketches," by Messrs. Macmillan and Co., Ltd., at 2s. 6d. The author believes that many teachers will find these drawings useful to accompany their lectures, even though they may not approve of text-books in general.

Messrs. J. and A. Churchill have published a second edition of "A Handbook of Physics and Chemistry," by Messrs. H. E. Corbin and A. M. Stewart. The primary object of the book is to meet the requirements of the first examination of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons, and the new matter which has been added should increase the book's sphere of usefulness.

Amateur photographers will be glad to know that Messrs. R. and J. Beck, Ltd., have issued a second edition of "Photographic Lenses; a Simple Treatise," by Messrs. Conrad Beck and Herbert Andrews. The book is intended as a practical guide for the photographer to enable him to use his apparatus to better advantage; it does not profess to give complete scientific explanations of the laws underlying the construction of photographic lenses.

The additions to the Zoological Society's Gardens during the past week include a Purple-faced Monkey (*Semnopithecus cephalopterus*) from Ceylon, presented by Mr. T. Jenkins; a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. C. A. Denison; a Long-tailed Weaver-bird (*Chera progne*) from South Africa, presented by Major R. W. P. Lodwick; a Brambling (*Fringilla montifringilla*), European, presented by Mr. H. Munt; a Large Grieved Tortoise (*Podocnemis expansa*) from the Amazons, presented by Senhor Francisco Alves Vieira; four Gallot's Lizards (*Lacerta galloti*) from Teneriffe, presented by the Hon. Rupert Drummond, R.N.; two Smith's Dwarf Lemurs (*Microcebus smithi*) from Madagascar, two Derbian Zonures (*Zonurus giganteus*), four Leopard Tortoises (*Testudo pardalis*) from South Africa, four Spanish Salamanders (*Chioglossa lusitanica*) from Spain, deposited; a Shining Parrakeet (*Pyrrhulopsis splendens*) from the Fiji Islands, purchased.

OUR ASTRONOMICAL COLUMN.

Nova Geminorum.—Further observations of the magnitude, appearance, and spectrum of this Nova have been made, and the results communicated to No. 3861 of the *Astronomische Nachrichten*.

Prof. Millosevich estimated the magnitude of the Nova on March 26d. 9h. (M.T. Rome) as 7·3–7·5, and recorded the colour as "yellow."

Dr. Halm, of Edinburgh, observed the spectrum with a small spectroscope attached to the 15-inch refractor on March 26, 27 and 28, and was convinced at first glance that the object was of the Nova type. On March 27 he found a faint continuous spectrum crossed by bright bands, those in the green and blue parts of the spectrum, including $H\beta$ and $H\gamma$, being especially conspicuous. The red part of the spectrum was very faint, and, although a careful scrutiny was made, no trace of the C line of hydrogen could be seen, but on observing the spectrum again on March 28 a bright point was seen to occupy that position. Dr. Halm estimated the magnitude of the Nova as about 8·0, and recorded the colour as a "bluish purple."

Drs. Ristenpart and Guthnick, of Berlin-Friedenau, made several estimations of the Nova's magnitude at 8·8h. (Central Europe M.T.) on March 29, and found for their general mean value 8·55m.

Prof. Hartwig, of Bamberg, estimated that the Nova was 0·3m. fainter on April 1 than it was on March 26, and Prof. Ceraski, of Moscow, estimated the magnitude as 8·3 at 10.30 p.m. on March 27. The latter observer could see no particular colour in the Nova, as it appeared white to him.

Spectrum of the Nebulosity Surrounding Nova Persei.—On account of the extraordinary changes of position and brightness in the nebula surrounding Nova Persei, Prof. Perrine, of Lick Observatory, thought it advisable to secure, if possible, a spectrum of the nebula, and for this purpose especially designed a spectroscope to be used with the Crossley reflector. The camera and collimator lenses were single quartz lenses of $1\frac{1}{8}$-inch aperture and 6 inches focal length; the prism also was quartz, and had a refracting angle of 50° 14′. A comparison spectrum of hydrogen was photographed on either side of the nebular spectrum.

A total exposure of 34h. 9m. was made on "condensation D" of the nebula on October 31, November 1, 2 and 4, and the resulting negative shows a very faint spectrum extending from $H\beta$ to about λ 360, its length being about 0·11 inch. A second negative was obtained in order to demonstrate that the spectrum was not due to skylight, whilst a spectrum of skylight was obtained and proved to be quite different to the supposed nebula spectrum, so that it may be taken as proved that the spectrum obtained on the first negative is really due to the nebulosity.

Fully three-fourths of the light in the spectrum is condensed in the region extending from $H\beta$ to $H\gamma$: above $H\gamma$ the spectrum is very faint, and between λ 380 and λ 390 it is entirely absent. There appears to be a line almost coincident with $H\delta$, and another at λ 370, but they are so faint that it is impossible to certify their presence.

It thus appears that the spectrum of the nebulosity corresponds to that of the Nova during the first few days of the latter's greatest magnitude in February, 1901. The positions of the two suspected lines at λ 410 and λ 370 do not agree at all with the strongest lines in the latest spectrum of the Nova, and there are no traces of the lines at λ 387 and λ 397 obtained by Campbell and Wright, nor of the very strong line at λ 346 photographed by Mr. Stebbins (Lick *Bulletin*, No. 8). The spectrum of the nebulosity is certainly not the ordinary bright line spectrum of the nebulæ, and if the latter is present at all, it is in conjunction with another spectrum, probably continuous, extending

from λ 434 to λ 487. A spectrum of the Nova obtained on February 17, 1903, does not agree with the spectrum of the nebulosity at all.

Prof. Perrine arrives at the conclusion, from the evidence given by these spectrographs, that the results do not oppose the theory that the light of the nebulosity—as considered in that part of it called condensation D—is due to the reflection of the light emitted by the Nova *at the time of its greatest brightness*, although, in face of the contradictory evidence already published, he does not consider his conclusions strong enough to prove the reflection theory (Lick Observatory *Bulletin*, No. 33).

STELLAR PARALLAX.[1]

FOR three years, from 1893 to 1896, Mr. A. S. Flint, of the Washburn Observatory, has devoted himself indefatigably to the determination of stellar parallax, and his results, contained in the eleventh volume of that observatory's publications, form a very handsome contribution to this class of inquiry. Not only are these results of great interest in themselves, but they offer a larger collection of new material than has ever been made on a single occasion. We have not only the observations of nearly a hundred stars, but all arranged and discussed on one uniform plan, a not unimportant factor in their bearing on the cosmical problem to which such results are applicable. The stars are scattered variously over the sky from the Pole to about 30° S. declination, and have been selected to include stars of considerable proper motion, a number of Prof. Burnham's double stars which show proper motion, and some twelve binary systems.

The method of observation was that suggested and employed by Prof. Kapteyn, namely, the chronographic registration of the time at which the selected star and two others, one preceding and one following, crossed the wires of the meridian instrument. The total number of observations, fairly evenly distributed between the morning and the evening, was 3059, all of which were made by Mr. Flint, while he is also responsible for the heavy work entailed in the discussion. Unfortunately, in this method of observation it is necessary to employ screens, varying in density, in front of the object glass, to reduce the light of the more brilliant star to approximately that of the stars of comparison. Experience has shown that very considerable errors are liable to be introduced in the determination of difference of R.A. when this precaution is overlooked. The ultimate value of the work will depend much on the success with which the screens are applied, and this source of error is eliminated. In this place we cannot enter fully into the devices employed or the discussion applied to the results. We can only say that the author has not found it sufficient to trust to the mechanical devices alone, but has had to submit his parallaxes to a further discussion, in order to remove systematic errors, and we can very well understand that this section of the work will be most carefully scrutinised by any astronomer who proposes to follow in the footsteps of Prof. Kapteyn or Mr. Flint.

The result of this examination is to determine a correction which the author has applied, and seeks to justify, depending on the difference of magnitude and the right ascension of the star. This correction can become so large that it might make one hesitate to apply the method in isolated instances, or wherever there is insufficient material to permit an independent inquiry. The correction which Mr. Flint applies to his parallax, or to the crude value resulting from the solution of the ordinary equations of condition, is $\frac{1}{2}$DM. y; where $\frac{1}{2}$DM. is the difference between the apparent magnitude of the parallax star and the mean magnitude of the two stars of comparison, and y is given by the expression

$$y = +0''\cdot067 + 0''\cdot101 \cos. \text{R.A.}$$

If, then, the reduced light of the parallax star differed by one magnitude from the mean of the other two, a correction of 0″·168 might result, and inasmuch as a difference of two magnitudes is not impossible, corrections of nearly four-tenths may be required, and in two instances 0″·36 is actually applied. This amount is a little startling, and though it would seem ungracious to suggest more work when so much has been attempted and carried to a successful issue, one cannot but wish that the author had made some complete sets of observations, without the use of a screen at all. Then, in the case of such a star as β Cassiopeiæ with its comparison stars, the amount of the correction would be some seven or eight-tenths of a second, a quantity which could not have escaped detection. To those who have not been engaged in similar inquiries it may seem strange that the error in R.A. arising from the observation of two stars of unequal magnitude is not constant, and therefore disappearing in the parallax. It may seem strange, too, that this puzzling discrepancy should vary with the time of year, for that is what the term depending on the right ascension practically means, but it must be sufficient here to refer to the volume itself, where the author has treated the matter in considerable detail, and given his figures in the clearest manner.

W. E. P.

[1] Publications of the Washburn Observatory of the University of Wisconsin. Vol. xi. "Meridian Observations for Stellar Parallax." First Series. By Albert S. Flint, Assistant Astronomer. Pp. 435. (Madison, Wis.: State Printer, 1902.)

RIDGWAY'S AMERICAN BIRDS.[1]

MR. RIDGWAY is making good progress with his laborious task, the first part of this work (already noticed in these columns) having been issued in 1901. The remaining volumes (probably six in number) are in a forward state, and it is hoped may be published at the rate of two a year. The present bulky volume is devoted to four families of the Passeres, namely, the tanagers (Tanagridæ), troupials (Icteridæ), honey-creepers (Cœrebidæ), and wood-warblers (Mniotiltidæ).

The author's introductory remarks on the first of these groups afford a curious comment on the prevalent practice of dividing the Passeres into families. For the division between the tanagers and the finches (Fringillidæ) is stated to be an arbitrary one, and the former group, as now restricted, is confessedly more or less artificial. Indeed, it is suggested that the fruit-eating forms (Euphoniæ) may eventually have to be separated as a distinct family group. The author has already relegated to the Fringillidæ several of the genera included by Mr. Sclater among the Tanagridæ, while others he assigns to the Mniotiltidæ. Moreover, the possession of only nine primary quills being now regarded as an essential feature of the family, the aberrant genus Calyptophilus must obviously find a place elsewhere. Apart from the case of the last-mentioned genus, all this suggests that, however convenient the division into "families" of such an unwieldy group as the Passeres may be for working purposes, such divisions possess little title to be regarded as important morphological units.

In adopting the term "troupials" as the English equivalent of the family Icteridæ, the author is decidedly well advised, and it may be hoped that the practice will be adopted by future writers. In the definition of this family the author makes the general absence or slight development of the rictal bristles an important feature; but no reference to these structures is made in the main definitions of the tanagers and honey-creepers, in which they may or may not be developed. This, we think, is an omission, although we are fully aware of the importance of making definitions as concise as possible. The general plan of the "keys" appears, as in the first volume, excellent, and the plates illustrative of the beak, wing, tail, and foot-structures of the various groups described are equally satisfactory.

R. L.

[1] "Birds of North and Middle America." By R. Ridgway. Part ii. (*Bull.* U.S. Nat. Mus., No. 50.) Pp. xx + 834; 22 plates. (1902.)

A PERIODICAL OF PRECIOUS PLANTS.

UNDER the title of *Flora and Sylva*, a new monthly periodical has appeared, edited by Mr. Robinson, and devoted to the illustration and description of "precious" plants, fitted for cultivation in these islands. It is beautifully printed in large type on good paper which allows of the woodcuts being properly printed. The illustration of the palmate bamboo on p. 3 is full of life, and forms a pleasing

contrast to many of the blotchy "process" illustrations now so common.

The coloured illustrations are good of their kind, but it needs the patience of a Bauer to do justice to such exquisite flowers as those of the Calochortus, and in the present instance the artist evidently prefers effect to detail.

Mr. Nicholson's article on Magnolias is likely to be of permanent value, and Mr. Carl Purdy's revision of the genus Calochortus will be useful to those who have not ready access to the more complete monograph in the *Proceedings* of the California Academy of Sciences.

"Sylva" is represented by an article on the Corsican pine, concerning which so much has been written of late years. Alluding to the great variation which occurs among the pines, the author of the article says that the "wild type of a forest tree is the best, and that sports are worthless." This is a statement that appears to require some modification. In the first place, it is not easy to determine what is the wild type. If we take the Corsican tree as the type, are we to abandon as worthless the black Austrian, the Pyrenean, the Calabrian, the Pallasian, and the many other varieties of the Corsican pine? But perhaps the writer does not include these as "sports." At any rate, in their several ways they are as valuable as the form arbitrarily taken as the type.

Flora and Sylva promises to be a very attractive and useful addition to garden literature.

INTERACTION BETWEEN THE MENTAL AND THE MATERIAL ASPECTS OF THINGS.[1]

THERE are certain ambiguous terms, to the undiscriminating use of which some misunderstandings are due. One of these is the term "science," which may be used either as synonymous with the unbiased and reverent pursuit of truth by patient and accurate methods in all departments of knowledge; or as representing the generally accepted notions of naturalists at any one epoch, together with such positive and negative tendencies and extensions into more speculative regions as may be favoured by them. The distinction between these two dissimilar things is hardly sufficiently accentuated by the use of a large or a small initial letter for the word.

Another ambiguous word is "faith," which may signify intellectual credence attached to some doctrine, in which case an emphatic and militant definite article is sometimes prefixed to it; or it may denote a moral, *i.e.* emotional and conative attitude to the universe in general, irrespective of intellectual cognisance of specific facts.

A third is the term "prayer," which again may represent either a submissive and devotional passive attitude of the soul in presence of a higher power, or an active and energetic petition for certain benefits or privileges, and especially for aid and guidance in crises or emergencies.

And lastly, many ambiguities, I venture to think, attach to the term "God," of which I will only mention three.

First, it may signify the highest theoretical and practical conception of men at any given epoch on this planet; a use of the term appropriate to the science of theology. Second, it may mean the Ultimate and Infinite and Absolute, concerning which no human predication is possible, and of which no even initially adequate conception can be made. Third, there are signs of its coming to be used in a limited sense by certain not unphilosophic persons—whether justifiably or not—to denote a Being, a ruler, an administrator, who is striving to evolve order out of mental and moral chaos, and to bring gradually towards perfection a race such as is competent to inhabit the surface of planets; the manager, so to speak, of the process of evolution. A being infinite in comparison to ourselves, but still a being with potentialities ahead, and with the possibility of advance, conditioned therefore to some extent by what we are conscious of as "time."

All these ambiguous terms are liable to enter into our present discussion, which concerns, I take it, fundamentally the intercommunion and interaction between the divine and the human, chiefly in the regions of volition and of action on the physical world. The influence of the divine on the human has been variously conceived in different ages, and various forms of difficulty have been at different times felt and suggested; but always some sort of analogy between human action and divine action has had perforce to be drawn in order to make the latter in the least intelligible to our conception. The latest form of difficulty is peculiarly deep-seated, and is a natural outcome of an age of physical science. It consists in denying the possibility of guidance or of control, not only on the part of a Deity, but on the part of every one of his creatures. It consists in pressing the laws of physics to what seems their logical and ultimate conclusion, in applying the conservation of energy without ruth or hesitation, and so excluding, as it has seemed, the possibility of free-will action, of guidance, of the self-determined action of mind or living things upon matter, altogether. The appearance of control has been considered illusory, and has been replaced by a doctrine of pure mechanism, enveloping living things as well as inorganic nature.

And those who for any reason have felt disinclined or unable to acquiesce in this exclusion of non-mechanical agencies, whether it be by reason of faith and instinct, or by reason of direct experience and sensation to the contrary, have thought it necessary of late years to seek to undermine the foundations of physics, and to show that its much-vaunted laws rest upon a hollow foundation, that their exactitude is illusory, that the conservation of energy, for instance, has been too rapid an induction, that there may be ways of eluding many physical laws and of avoiding submission to their sovereign sway.

By this sacrifice it has been thought that the eliminated guidance and control can philosophically be reintroduced.

This, I gather, may have been the chief motive of an attack on physics led by an American, J. B. Stallo, in a little book called the "Concepts of Physics," which has at various times attracted some attention. But the worst of that book was that Stallo was not really familiar with the teachings of the great physicists; he appears to have collected his information from popular writings, where the doctrines were very imperfectly laid down; so that most of the book is occupied in demolishing constructions of straw, unrecognisable by professed physicists except as caricatures at which they also might be willing to heave an occasional missile.

The armoury pressed into the service of Prof. James Ward's attack is of weightier calibre, and his criticism cannot in general be ignored as based upon inadequate acquaintance with the principles under discussion; but still his Gifford lectures raise an antithesis or antagonism between the fundamental laws of mechanics and the possibility of any intervention, whether human or divine.

If this antagonism is substantial it is serious; for natural philosophers will not be willing to concede fundamental inaccuracy or uncertainty about their recognised and long-established laws of motion, nor will they be prepared to tolerate any the least departure from the law of the conservation of energy. Hence, if guidance and control can be admitted into the scheme by no means short of refuting or modifying those laws, there may be every expectation that the attitude of scientific men will be perennially hostile to the idea of guidance or control, and so to the efficacy of prayer, and to many another practical outcome of religious belief. It becomes therefore an important question to consider whether it is true that life or mind is incompetent to disarrange or interfere with matter at all, except as an automatic part of the machine, or rather except as an ornamental appendage or dependent accessory of its working parts.

Now experience—the same kind of experience as gave us our scheme of mechanics—shows us that to all appearance live animals certainly can direct and control mechanical energies to bring about desired and preconceived results, *e.g.* the Forth Bridge. Undoubtedly our body is material and can act on other matter, and its energy is derived from food, like any other self-propelled and fuel-fed mechanism; the question is whether our will or mind or life can direct our body's energy along certain channels to attain desired

[1] Read to the Synthetic Society in London on February 20. The paper is supplementary to a couple of articles on "Science and Faith," by the same author, in the *Hibbert Journal* for October, 1902, and January, 1903; and it states, for the purpose of discussion, the salient arguments on which those articles were based.

ends; or whether direction, as well as amount, of activity is wholly determined by mechanical causes.

Answers that might be given are :—

(*a*) That life is a form of energy, and achieves its results by imparting to matter energy that would not otherwise be in existence, in which case life is a part of the machine, and as truly mechanical as all the rest. I hold that this is false; because the essence of energy is that it can transform itself into other forms, remaining constant in quantity, whereas life does not transmute itself into any form of energy, nor does death affect the sum of energy in any known way.

(*b*) That life is something outside the scheme of mechanics, although it can nevertheless touch or direct material motion, subject always to the laws of energy and all other mechanical laws; supplementing them, but contradicting or traversing them no whit.

This I hold to be true; but in order to admit its truth we must recognise that triggers can be pulled—force exerted, and energy directed—without any introduction of energy from without; in other words, that the energy of operations automatically going on in any active region of the universe —any region where transformation and transference of energy are continuously occurring, whether life be present or not—that this energy can by means of life be guided along paths that it would not automatically have taken, and can be directed so as to produce effects that would not otherwise have occurred; and this without any break or suspension of the laws of dynamics.

That is where I part company with Prof. James Ward in the second volume of "Naturalism and Agnosticism," notwithstanding that I feel sure that Mr. A. J. Balfour agrees with him.

Those who take his view must either throw overboard the possibility of interference or guidance or willed action altogether, which is one alternative, or must assume that the laws of physics are only approximate and incomplete, which is the other alternative—the alternative favoured by Prof. James Ward. I wish to argue that neither of these alternatives is necessary, and that there is a third or middle course of proverbial safety.

On a stagnant and inactive world life would be admittedly powerless; it could only make dry bones stir in such a world if itself were a form of energy; I do not suppose for a moment that it could be incarnated on such a world; it is only potent where inorganic energy is in constant process of transfer and transformation. In other words, life can generate no trace of energy, it can only guide it.

Guidance is a passive exertion of force without doing work; as a quiescent rail can guide a train to its destination, provided an active engine propels it. If a stone is rolling over a cliff, it is all the same to "energy" whether it fall on point A or point B of the beach. But at A it shall merely dent the sand, whereas at B it shall strike a detonator and explode a mine. Scribbling on a piece of paper results in a certain distribution of fluid and production of a modicum of heat; so far as energy is concerned, it is the same whether we sign Andrew Carnegie or Alexander Coppersmith, yet the one effort may land us in twelve months' imprisonment or may build a library, according to circumstances, while the other achieves no result at all. John Stuart Mill used to say that our sole power over Nature was to *move* things; but strictly speaking we cannot do even that; we can only arrange that things shall move each other, and can determine by suitably preconceived plans the kind and direction of the motion that shall ensue at a given time and place. Provided always that we include in this category of "things" our undoubtedly material bodies, muscles and nerves.

But here is just the puzzle; at what point does will and determination enter into the scheme? Contemplate a brain cell, whence originates a certain nerve-process whereby energy is liberated with some resultant effect; what pulled the detent in that cell which started the impulse? No doubt some chemical process, combination or dissociation, something atomic, occurred; what made it occur just then and in that way?

I answer, the same sort of prearrangement that determined whether the stone from the cliff should fall on point A or point B—the same sort of process that guided the pen to make legible and effective writing instead of illegible and ineffective scrawls—the same kind of process that determines when and where a trigger shall be pulled so as to secure the anticipated slaughter of a bird. So far as energy is concerned, the explosion and the trigger-pulling are the same identical operations, whether the aim be exact or random. It is vitality which directs; it is physical energy which is directed and controlled both in time and space.

I lay stress upon a study of the nature and mode of human action of the interfering or guiding kind, because from it we must be led if we are to form any intelligent conception of divine action. True, it might be possible to deny human agency or power and yet to admit the possibility of divine agency, though that would be a nebulous and at least inconclusive procedure; but if we are once constrained to admit the existence and reality of human guidance and control, we cannot deny the possibility of such powers and action to any higher being, nor even to any totality of things of which we are a part.

The point immediately at issue turns upon the distinction between "force" and "energy." These terms have been so popularly confused that it may be difficult always to discriminate them, but in physics they are absolutely discriminated. A force in motion is a "power," it does work and transfers energy from one body to another. But a force at rest—a mere statical stress, like that exerted by a pillar or a watershed—does no work, and alters no energy; yet the one sustains a roof which would otherwise fall, thereby screening a portion of ground from vegetation; while the other deflects a rain-drop into the Danube or the Rhine.

It will be said *some* energy is needed to pull a hair-trigger, to open the throttle valve of an engine, to press the button which shall shatter a rock. Granted; but the work-concomitants of that energy are all familiar, and equally present whether it be so arranged as to produce any predetermined effect or not. The opening of the throttle valve, for instance, demands just the same exertion, and results in just the same imperceptible transformation of fully-accounted-for energy, whether it be used to start a train in accordance with a time-table and the guard's whistle, or whether it be pushed over as by the wind at random. The shouting of an order to a troop demands vocal energy, and produces its due equivalent of sound; but the intelligibility of the order is something superadded, and its result may be to make not sound or heat alone, but history.

Energy is needed to perform any physical operation, but the energy is independent of the determination or arrangement. Guidance and control are not forms of energy, and their superposition upon the scheme of physics perturbs physical and mechanical laws no whit, though it may profoundly affect the consequences resulting from those same laws. The whole effort of civilisation would be futile if we could not guide the powers of nature. The powers are there, else we should be helpless; but life and mind are outside those powers, and can direct them along an organised course.

And this same life or mind, as we know it, is accessible to petition, to affection, to pity, to a multitude of non-physical influences; and hence, indirectly, the little plot of physical universe which is now our temporary home has become amenable to truly spiritual control.

My contention, then, is that whereas life cannot generate energy, it can exert guiding force, using the term force in its accurate mechanical sense; not "power" or anything active, but purely passive, directing—perpendicular to the direction of motion; the same kind of force which can constrain a stone to revolve in a circle instead of in a straight line; a force like that of a groove or slot or channel or "guide."

I do not see how this action of life can be resented, except by those who deny life to be anything at all. If it exists, if it is not mere illusion, it appears to me to be something the full significance of which lies in another scheme of things, but which touches and interacts with this material universe in a certain way, building its particles into notable configurations for a time—oak, eagle, man—and then evaporating whence it came. This language is vague and figurative undoubtedly, but, I contend, appropriately so, for we have not yet a theory of life—we have not even a theory of the

essential nature of gravitation; discoveries are waiting to be made in this region, and it is absurd to suppose that we are already in possession of all the data. We can wait; but meanwhile we need not pretend that because we do not understand it, therefore life is an impotent nonentity. I suggest that the philosophic attitude is to observe and recognise its effects, both what it can and what it cannot achieve, and realise that our theory of it is at present extremely partial and incomplete.

Summary.

The chief contentions are:—

(1) That the fundamental laws of physics, complete and accurate as they are, in no way exclude guidance of events by the agency of life or mind or other unknown influence.

(2) That common experience shows that living creatures do exert such guidance, and further, that they are amenable to non-material or spiritual influences from each other.

The dualistic form of this language is a necessity of expression, and inevitable for practical purposes; it is not intended to imply any ultimate or philosophic dualism. The writer finds himself unable, with his present knowledge, to use language appropriate to unification, which he regards as an aim rather than as an achievement.

Oliver J. Lodge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At a meeting of the Senate of Dublin University on April 18, the degree of doctor in science was conferred *honoris causa* on Sir William Abney, K.C.B.

At the graduation ceremony of the University of Glasgow on Tuesday, the honorary degree of LL.D. was conferred *in absentia* on Sir William Gairdner, emeritus professor of medicine in the University; and the same degree was received by Sir Norman Lockyer, K.C.B.; Dr. Thomas Oliver, professor of physiology in the University of Durham; and Mr. Philip Watts, Director of Naval Construction at the Admiralty.

At a meeting of the governors of the North Wales University College, held on April 15, it was announced that subscriptions amounting to more than 15,000*l.* towards providing additional buildings had been promised, among the subscribers being the King and the Prince of Wales. It was also stated that the Drapers' Company had offered 600*l.*, payable in three annual instalments, towards the maintenance of an electrical engineering department.

The Technical Education Board of the London County Council is offering for competition five senior county scholarships, together with several senior exhibitions. The scholarships are of the value of 90*l.* a year, and are tenable, in ordinary circumstances, for three years at universities, university colleges, or technical institutes, whether at home or abroad. They are confined to persons who are resident within the administrative county of London, and whose parents are in receipt of an income of not more than 400*l.* a year from all sources. The scholarships are open to candidates under twenty-two years of age on June 1, preference being given to candidates who are under nineteen years of age. No examination is held for these scholarships and exhibitions, which are awarded on consideration of the past record and future promise of the candidates. Candidates who desire to apply for the scholarships and exhibitions can obtain application forms from the secretary of the Technical Education Board, 116 St. Martin's Lane, W.C. These forms must be returned not later than Monday, May 11.

Following the suggestion of the executive committee of the Nature-Study Exhibition Association, contained in their official report, that the work of the Association would in future be carried out more satisfactorily by local organisations, certain delegated members of the Middlesex Field Club and of the Selborne Society are arranging to hold this year in London a Home Counties Nature-Study Exhibition. Lord Avebury is the chairman of the committee, and already the list of patrons is very representative. The honorary secretary, Mr. W. M. Webb, will be glad to receive at 20 Hanover Square, W., donations towards the expenses of the exhibition.

The governing body of the Royal Agricultural College, Cirencester, has decided, in consequence of the recommendation of the recent report on British forestry, to remodel and largely develop the teaching of forestry at the college in connection with the estate management branch of the curriculum. It has been resolved to create a new chair, to be entitled the chair of estate management and forestry, and to appoint thereto a special professor or lecturer who shall be required to devote all his time to the duties of the chair, and who shall have had good experience, not only of the management of woods in this country, but also of the continental system of sylviculture followed in the State and Communal forests of France and Germany.

The Berlin correspondent of the *Times* states that on October 1 the courses of instruction are to be begun at the new military technical college which is to be established in Berlin. Not more than fifty officers, who must be of such an age that they will not attain the rank of captain while seconded for these instructional courses, will, in the first instance, be summoned to the capital. They will have to show a sufficient knowledge of mathematics and physics, and must produce proofs of their general military efficiency. The full course will last three years, but officers will have to satisfy the authorities at the end of each year that it is desirable that they should continue their studies. In connection with the military subjects of the courses of instruction, lectures will be given on mathematics, physics, mechanics, electricity, chemistry, metallurgy, and surveying.

The Senate of the University of London has approved the following scheme of courses in advanced botany, extending over the years 1903–6, drawn up by the Board of Studies in Botany. The general idea is that each course should deal with a definite branch of botanical knowledge or with the more general aspects of the science, and should extend to about ten lectures:—1903–1904—The plant in relation to the soil, Mr. A. D. Hall; the Lycopsida, Dr. D. H. Scott, F.R.S.; the metabolic processes of plants, Prof. J. Reynolds Green, F.R.S. 1904–1905—Botany and its present problems, Sir William Thiselton-Dyer, F.R.S.; the Ascomycetes, with especial reference to the typical fructifications, Mr. V. H. Blackman; respiration, Prof. J. B. Farmer, F.R.S.; the Tubifloræ, Dr. A. B. Rendle. 1905–1906—Gymnosperms, Prof. F. W. Oliver; the British flora in its ecological relations, Mr. A. G. Tansley; Bryophytes, Prof. J. B. Farmer, F.R.S.

Representatives from the principal universities and colleges of New York State recently met at Columbia University to determine the basis upon which the award of the two Rhodes scholarships for New York State should be made. It was decided, says *Science*, to entrust the administration and award of the scholarships to a committee of three, to be elected by the heads of the colleges for men. The committee will consist of President Butler, President Schurman, and Chancellor Day. The conference decided that the conditions regulating the award shall be as follows:—The candidates for the scholarships to be eligible shall have satisfactorily completed the work of at least two years in some college of liberal arts and sciences in the State. Except in extraordinary circumstances, the upper age limit shall be twenty-four years at the time of entering upon the scholarship at Oxford. To be eligible, the candidate shall be a citizen of the United States and unmarried.

SCIENTIFIC SERIAL.

Journal of Botany, April.—Two brief notes by Mr. G. West and Mr. J. Cryer refer to a Polygala identified as *amarella*, Crantz, which was collected on the Great Scar Limestone near Grassington.—For the East Riding of Yorkshire Mr. W. Ingham publishes a list of mosses and hepatics.—A new fossil fungus, a species of Cercosporites, is described and figured by Mr. E. S. Salmon. It was obtained from the "disodile" beds in Sicily.—Mr. S. Moore, in the identification of some plants, chiefly Compositæ, from the Transvaal, Griqualand West and British East Africa, has found several new species, for which descriptions are given.—Mr. E. S. Linton supplies a list of "Kent Rubi," and Mr. W. G. Smith has a note on a new species of Collybia.

SOCIETIES AND ACADEMIES.

London.

Royal Society.—"A New Form of Self-restoring Coherer." By Sir Oliver **Lodge**, F.R.S. Communicated verbally March 12, received in manuscript March 18.

The essential part of the receiving instrument now always employed in the system of Hertzian telegraphy, which Dr. Muirhead and the author had brought out and always now employed, and which their assistant, Mr. E. E. Robinson, had helped to work out, might be described as a development of the mercury form of coherer described some years ago by Lord Rayleigh, and again in a modified fashion by Mr. Rollo Appleyard. In Lord Rayleigh's form this consisted of a pool of mercury cut across with a paraffined knife, and the two half pools connected to a battery and key. As soon as the key was depressed so as to throw a few volts on to the intervening film of oil, the electrostatic pressure seemed to squeeze the oil out, and the pools of mercury became one. The pressure exerted by a few volts on a film of barely soap-bubble thickness is very considerable, and comparable to a ton per square inch.

Needle points dipping in oil and mercury were tried as practical coherers, the points being pulled out electromagnetically every time a signal arrived. Rotating forms of contact for automatic decoherence were also tried in various forms, and ultimately the method took the form of a rotating sharp-edged steel wheel, about half an inch in diameter, constantly touching a pool or column of mercury on which was a thin layer of oil. No effective contact occurs between the wheel and the mercury, notwithstanding the immersion, because of the film of oil; but the slightest difference of potential applied to the two, even less than one volt, is sufficient to break the film down and complete a circuit, which, however, the rotation of the wheel instantaneously breaks again. A spark is so sudden that for its purposes the wheel is for the instant virtually stationary, and yet the decohesion is so rapid that signals can be received in very rapid succession. The definiteness of the surfaces and of the intervening layer make the instrument remarkably trustworthy, and the thinness of the insulating film makes it very sensitive. In fact a single cell of a battery cannot be employed as a detector, because it is of too high a voltage for the film to stand. A fraction of a volt is employed, by a potentiometer device—usually something like one-tenth of a volt—and it is adjusted to suit circumstances. The battery acts through the coherer direct on a low resistance recorder, and the record on the strip shows every character of the arriving pulses, and exhibits any defect in the signalling. Provided that every joint and contact, except the one intended to be filmed, is thoroughly good, the coherer in this form is so definite and satisfactory that it becomes safe to say that the only outstanding defects are those which occur at the sending end. The signals are picked up and recorded precisely as they are emitted, as has been tested by intercalating a siphon recorder in a much diluted tapping circuit at the sending end, so as to get a record with which to make comparison. The traces obtained at the two ends are identical to a surprising degree.

The mercury level has an adjustment which is easily made. One precaution is to keep the rim of the wheel clear of dust, which is done by a cork or leather pad pressed lightly against it by a spring.

The instrument is not at all sensitive to tremor, and requires no particular delicacy of adjustment. The wheel has to be positive, the mercury negative.

A telephone in circuit, through a transformer or otherwise, affords an easy method of occasionally discriminating the signals by ear. The speed of the wheel gives another convenient adjustment to suit various circumstances.

A simple laboratory form of the instrument, driven by a thread from Morse clockwork, can be placed in circuit with a simple form of potentiometer and a siphon recorder, and used for Hertz-wave investigation purposes. It is connected with the collecting areas through a transformer, the coils of the recorder being in that case shunted by means of a condenser, so as to allow the full effect of the impulse to be felt at the film without having to overcome anything of the nature of a choke coil or other obstruction, in cases where sensitiveness is desirable.

Royal Astronomical Society, April 8.—Prof. H. H. Turner, president, in the chair.—Prof. **Sampson** gave an account of the Almucantar erected under his supervision at the Durham Observatory, and described the instrumental errors, and methods of adjustment of the instrument, and the observations made with it during 1902.—The **Astronomer Royal** exhibited photographs of the recent sunspots, and curves showing the terrestrial magnetic disturbances which had accompanied the outbreak of solar activity. In the course of the discussion Prof. Turner showed a photograph of solar faculæ, &c., taken by Prof. G. E. Hale with the spectroheliograph at the Yerkes Observatory.—Mr. F. A. **Bellamy** read a paper on the new star in Gemini found by Prof. Turner from an examination of astrographic plates taken at the Oxford University Observatory. There was no trace of the star on plates taken February 21 and 28, but on March 16 it appeared as of the seventh magnitude. Prof. Pickering had since examined the plates taken at Harvard Observatory, and found an image of the star on a photograph of March 6, though there was no trace of it on earlier plates. On March 6 the Nova was of the fifth magnitude; it had therefore considerably diminished in brightness when found at Oxford, and appeared to be still slowly becoming fainter. The spectrum showed many bright lines.—Father **Goetz** gave an account of observations proposed to be made at a new observatory to be established in Bulawayo, Rhodesia, and of which he was about to take charge.—Prof. Michie **Smith** described the new observatory at Kodaikánal, in southern India, illustrated by photographs of the observatory and its surroundings, and gave a brief account of the observations being made there.

Entomological Society, April 1.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. M. **Jacoby** exhibited specimens of *Rhagiosoma madagascariensis*, Heyd., from Madagascar, and *Carpophagus Banksiae*, McLeay, and *Mecynodera coxalgica*, Boisd., from Australia. In appearance they presented many characteristics not usually associated with Phytophagous Coleoptera.—Mr. C. P. **Pickett** exhibited specimens of *Dilina tiliae* bred from Essex pupæ, showing the effects of forcing.—Mr. W. J. **Lucas** exhibited lantern slides of the specimen of *Hemianax ephippiger*, and of the Orthetrum species attacked by an Asilid fly, shown by Mr. R. McLachlan at the last meeting.—Dr. T. A. **Chapman** read contributions to the life-history of *Orina* (*Chrysochloa*) *tristis*, var. *smaragdina*.—Mr. F. **Enock** read a paper, illustrated with lantern slides, on the life-history of *Cicindela campestris*.—Sir George **Hampson** read a paper on *Apoprogonia hesperioides*, a remarkable new lepidopterous insect from Zululand. He said that the genus must be referred to the Euschemonidæ, which is represented by the single species *Euschemon rafflesiae*, Westw., from Australia. In what quarter of the globe the family originated it was impossible to say, but the appearance of the species in question suggested that it was a survival of the scattered remnant of the Antarctic fauna. It was, however, most remarkable that the genus should occur in Africa and Australia alone.

Royal Meteorological Society, April 15.—Captain D. Wilson-Barker, president, in the chair.—Mr. F. J. **Brodie** read a paper on the prevalence of gales on the coasts of the British Islands during the thirty years 1871–1900, being a continuation of a paper on the same subject which he communicated to the Society last year. The total number of gales dealt with during this period was 1455, the yearly average being 48·5, of which 10·6 were severe. The present paper deals with (1) the number of gales experienced on the west, north, south, and east coasts respectively, (2) the prevalence of gales at different times in the year, and (3) the mean direction from which gales blow on various parts of our coasts.—A paper on the duration of rainfall, by Mr. J. **Baxendell**, was read by the secretary. In this paper the author refers to various patterns of self-recording rain-gauges, and points out the defects inherent to them, and also states that it is hardly possible to determine from them the rate at which rain falls, especially in very small quantities. From a Halliwell's self-recording rain-gauge which had been in operation at Southport during 1902, the total duration of rainfall for the year was 640·1 hours. The author showed that the hourly duration values give a

striking curve of diurnal variation, the early morning maximum being most pronounced; the afternoon one is also present, but is much less protracted and of far less amplitude than the former. Minima occur about mid-day and in the evening. The author concluded by giving an account of Halliwell's float pattern self-recording rain-gauge.

Mathematical Society, April 16.—Dr. E. W. Hobson, vice-president, in the chair.—Mr. C. S. **Jackson** exhibited the logo-logarithmic slide-rule constructed from a design prepared by Colonel Dunlop and himself, and gave an account of the history of the invention. In principle it goes back to the early part of the nineteenth century.—The following papers were communicated:—Prof. A. **Lodge**, Relations between points (in a plane) having conjugate complex coordinates. This is an addition to a paper read at the meeting in January, 1903.—Prof. A. E. H. **Love**, Note on exact solutions of the problem of the bending of an elastic plate under pressure. The method given by Michell in *Proceedings*, vol. xxxi., yields exact solutions of the problem, which can be determined completely when the plate is bent by uniform pressure applied to one face, or by pressure varying uniformly over the face, and the (clamped) edges are circular or elliptic. For any form of clamped edge the deflexions produced by such pressures are determined by the same differential equations and boundary conditions as arise in the ordinary approximative theory. The principles on which the ordinary theory is founded are true to a certain order of approximation only. The small corrections which must be made do not affect much the calculation of the strength of the plate to resist bending, but they account rationally for the existence of the shearing stresses and of the tension (analogous to that of a membrane) by which the pressure is balanced. Under uniform pressure the median plane of the plate is unstrained, but under varying pressure this surface undergoes a small extension.—Mr. E. T. **Whittaker**, On those functions which are defined by definite integrals with not more than two singularities. Among the functions included in this class are the Bessel functions, the error-function, the logarithm-integral, the cosine-integral. A definite integral containing two numerical parameters is discussed, and it is shown how, by specialisation of the parameters, the above-mentioned functions and many others can be obtained. The functions defined by the definite integral satisfy a linear differential equation of the second order which is a generalisation of Bessel's equation; they possess asymptotic expansions, and are connected by recurrence-formulæ and integral-formulæ analogous to those which hold in the case of Bessel functions. Attention is drawn to new functions included in the class defined by the general definite integral.—Mr. H. **MacColl**, On the validity of certain formulæ. The paper contains a criticism of certain formulæ in the algebra of logic. Mr. A. **Young**, On covariant types.—Mr. R. F. **Gwyther**, On the deduction of Schlömilch's series from a Fourier series, and its development into a definite integral. The paper presents a demonstration of the connection of Schlömilch's expansion of an arbitrary function in a series of Bessel functions of order zero with Fourier's expansion of the same function in terms of cosines. Both expansions can be represented by the same surface integral, and the one is transformed into the other by change of the variables in the double integral.—Messrs. H. W. **Richmond** and T. **Stuart**, The inflexion-conic of a trinodal quartic curve. It is known that the six points of inflexion of a trinodal quartic curve lie on a conic. The paper contains two simple proofs of this theorem, and the equation of the conic is obtained explicitly in various systems of coordinates.

Edinburgh.

Royal Society, February 16.—Lord M'Laren in the chair.—Dr. J. **Beard** communicated a paper on the embryology of tumours, in which, after a critical examination of the theories which had been brought forward, he gave a detailed description of his own views. The continuity of germ cells from generation to generation was now becoming generally accepted among embryologists. The fertilised egg did not, however, give rise directly to an embryo, but rather to a set of germ cells, every one of which had the power, with appropriate environment, of developing into an embryo. The number of germ cells in a particular species was always some power of two; for example, eight in the frog, thirty-two in the lamprey, 128 in the dog-fish, &c. Of these one went to form the embryo, and the remainder migrated or wandered about in the embryonic body to furnish the foundation of the reproductive products. A certain percentage would get hopelessly wandered, and never find their way to the normal position. It was in these aberrant or "lost" germ cells that Dr. Beard found the origin of tumours. In short, a tumour was a more or less reduced, more or less incompletely differentiated sterile Metazoan organism. It started by the abnormal development of a vagrant germ cell, and growing under conditions unfavourable to the complete and normal differentiation of all its parts, it unfolded and developed those things for the growth of which the nidus was suitable, the rest degenerating. Exactly as identical twins were the offspring of two sister or brother germ cells identical in ancestry from the same primitive germ cell, so any animal and a tumour within it stood in the same relation of ancestry from one primitive germ cell.—Sir John **Murray** communicated some preliminary observations on seiches in certain Scottish lochs, and exhibited a seichometer with which he hoped in the coming season to get a more definite and precise record of these oscillations.—Prof. **Chrystal** then gave an account of the theory of seiches, touching on the work that had been done by the Swiss and American investigators, and developing the mathematical theory in a form convenient for application. The theory was illustrated by a series of experiments in a rectangular trough, carried out with great skill by Mr. E. Maclagan Wedderburn, the characters of the uninodal and binodal seiches and the influence of a shelving bottom being well brought out.—A short paper was presented by Prof. **Anglin** on the equation of a pair of tangents to a conic.

Dublin.

Royal Dublin Society, March 17.—Mr. Samuel Geoghegan in the chair.—On the petrological examination of paving sets, by Prof. J. **Joly**, F.R.S. By examination of the worn surfaces of many different sorts of paving sets, in conjunction with petrological examination of the rock, it is found possible to connect the qualities of the set with the nature and relative amounts of the mineral constituents present in the rock. The petrological examination of the rock now becomes a very sure guide in the examination of an untried set; its degree of durability and roughness under wear can be foretold with a high degree of certainty.—Mr. William **Tatlow** exhibited and described an aluminium rectifier for alternating electric currents, and a three-phase rotary converter.

Paris.

Academy of Sciences, April 14.—M. Albert Gaudry in the chair.—On certain algebraic surfaces for which the integrals of the total differentials reduce to algebraical logarithmic combinations, by M. Émile **Picard**.—On the discussion and integration of differential equations of the second order with constant coefficients, by M. E. **Vallier**.—The catalytic decomposition of alcohols by finely divided metals; primary alcohols, by MM. Paul **Sabatier** and J. B. **Senderens**. The reactions previously described for ethyl alcohol have been extended to higher alcohols of the same class, and it has been found that, with reduced copper between certain limits of temperature, the alcohol is split up into the corresponding aldehyde and hydrogen, without any secondary reactions of importance. With reduced nickel the reaction is more violent, the aldehyde formed being further acted upon.—The sounds emitted by sand in motion, by M. **Lortet**.—On the projection of matter round the electric spark, by M. Jules **Semenov**. From the experiments described it would appear that gases and vapours, traversed by a spark, are thrown out by it in all directions, as a consequence of the sudden elevation of temperature. The direction of the current does not appear to have any effect upon the sense of this projection.—The action of radio-active bodies on the electric conductivity of selenium, by M. Edmund von **Aubel**. The radio-active bodies examined acted upon selenium in a manner resembling light or the Röntgen rays, but the effect is produced much more slowly.—On the electric and magnetic dichroïsm of liquids, by

M. Georges **Meslin.**—An experimental contribution to the physiology of death, by MM. N. **Vaschide** and Cl. **Vurpas.** —On the principal alimentary Leguminosæ of the French colonies, by M. **Balland.**

St. Louis.

Academy of Science, April 6.—Prof. F. E. Nipher reported that he had apparently succeeded in producing a distortion of a magnetic field by means of explosions. The apparatus used was a transformer consisting of concentric coils wound upon brass tubes. The outer tube was five inches in diameter and six feet long, wound with more than four thousand windings of No. 16 wire. This coil was traversed by a continuous current from a storage battery. Within this, and separated from it by an air-space of an inch, is a secondary coil of equal length, having more than twenty-five thousand windings of No. 25 wire. This coil is connected to a D'Arsonval galvanometer. Within the tube on which this coil is wound is a smaller brass tube within which a train of black gunpowder is laid. This tube is open at both ends, and has practically no recoil when the explosion is made. When hung by a bifilar suspension on cords ten feet in length, the recoil is about an inch. When the exciting current is small compared with the capacity of the battery, the galvanometer reading is very steady. When the train is exploded, a sudden and marked throw of the galvanometer results, which could be accounted for by an increase in the permeability of the long explosion chamber. The deflection reverses when the field is reversed. The hot gases liberated in the explosion are all diamagnetic, and tend to decrease the observed effect. In two cases the galvanometer deflection was in the opposite direction from that stated above, and this is being further inquired into. When seven tubes between the two coils are simultaneously exploded, only slight effects can be obtained, and these deflections are wavering, or to and fro, in character. A wire was threaded through the inner combustion tube, through which a current of three amperes was passed. This circuit was opened and closed with no visible effect. The galvanometer circuit is shielded by tin-foil, which is also connected with the explosion tube, and grounded. Sparks an inch long to the tin-foil produce no result. When the explosion tube is removed from the transformer, and taken near the galvanometer or the storage battery, no deflection is produced by the explosion. An explosive mixture of gases from water electrolysis under atmospheric pressure produces a much less violent explosion, and produces a correspondingly less effect. The scale reading of the galvanometer changes by more than twenty divisions with the heaviest explosions, and an exciting current of 0·6 ampere. With smaller explosions or feebler currents, the effect is diminished. No deflections can be produced by striking the table upon which the transformer rests, nor by striking the transformer itself, even when it moves slightly under the blow. The secondary and primary coils are held rigidly in fixed position with respect to each other. Arrangements have now been made to place the explosion tube in the focal line of a parabolic cylinder of metal, the galvanometer coil being in the focal line of a similar mirror. Either or both are to be surrounded by an exciting coil. This line of research was suggested by Young's account of his observation of five solar outbursts in 1872, which were each accompanied by sharp fluctuations in the magnetic tracings at Kew and Stonyhurst.

DIARY OF SOCIETIES.

THURSDAY, April 23.

Royal Institution, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

Society of Arts, at 4.30.—The Province of Sind: Dr. Herbert M. Birdwood.

Institution of Electrical Engineers, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms: M. B. Field. *And, if time permit.*—Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals: W. Aitken.

FRIDAY, April 24.

Royal Institution, at 9.—Some Recent Investigations on Electrical Conduction: The Hon. R. J. Strutt.

Institution of Civil Engineers, at 8.—Bacterial Sewage-Disposal Works, at Ash, Dover: H. S. Watson.

Physical Society, at 5.—An Electrical Thermostat: H. Darwin.—Dimensional Analysis of Physical Quantities and the Correlation of Units: A. F. Ravenshear.—Note on the Dimensions of Physical Quantities: R. J. Sowter.

Institution of Mechanical Engineers, at 8.—Address by the president, J. H. Wicksteed.—The Education of Engineers in America, Germany and Switzerland: Prof. W. E. Dalby.

MONDAY, April 27.

Society of Arts, at 8.—Mechanical Road Carriages: W. Worby Beaumont.

Royal Geographical Society, at 8.30.—Four Years' Arctic Exploration in the *Fram*: Captain Otto Sverdrup.

Institute of Actuaries, at 5.—On the Valuation of Staff Pension Funds. Part II. Widows' and Children's Pensions: H. W. Manly; With Tables by H. Foot.

TUESDAY, April 28.

Royal Institution, at 5.—The Blood and some of its Problems: Prof. Allan Macfadyen.

Society of Arts, at 7.30.—Visit to the Whitefriars' Glass Works.—Modern Table Glass: Harry Powell.

Anthropological Institute, at 8.15.—The Classification of the Materials of Anthropology: E. N. Fallaize.—Measurements of the Colonial Coronation Contingent: J. Gray.—Implements used by West Australian Natives in Manufacture of Glass Spear-Heads: H. Balfour.

WEDNESDAY, April 29.

Society of Arts, at 8.—Automatic Wagon Couplings on British Railways: T. A. Brockelbank.

Geological Society at 8.—The Age of the Swiss Alpine Lakes: Dr. C. S. DuRiche Preller.—On a Shelly Boulder-Clay in the so-called Palagonite-Formation of Iceland: Helgi Pjetursson.

THURSDAY, April 30.

Royal Society, at 4.30.—Croonian Lecture: The Cosmical Function of the Green Plant: Prof. K. A. Timirjazev.

Royal Institution, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

FRIDAY, May 1.

Royal Institution, at 9.—Recent Advances in Stereochemistry: Prof. W. J. Pope.

CONTENTS.

THURSDAY, APRIL 30, 1903.

RADIUM.

THE discovery by Monsieur and Madame Curie that a sample of radium gives out sufficient energy to melt half its weight of ice per hour has attracted attention to the question of the source from which the radium derives the energy necessary to maintain the radiation; this problem has been before us ever since the original discovery by Becquerel of the radiation from uranium. It has been suggested that the radium derives its energy from the air surrounding it, that the atoms of radium possess the faculty of abstracting the kinetic energy from the more rapidly moving air-molecules while they are able to retain their own energy when in collision with the slowly moving molecules of air. I cannot see, however, that even the possession of this property would explain the behaviour of radium; for imagine a portion of radium placed in a cavity in a block of ice; the ice around the radium gets melted; where does the energy for this come from? By the hypothesis there is no change in the energy of the air-radium system in the cavity, for the energy gained by the radium is lost by the air, while heat cannot flow into the cavity from outside, for the melted ice around the cavity is hotter than the ice surrounding it.

Another suggestion which has been made is that the air is traversed by a very penetrating kind of Becquerel radiation, and that it is the absorption of this radiation that gives the energy to the radium. We have direct evidence of the existence of such radiation, for McClennan and Burton have recently shown that the ionisation of a gas inside a closed vessel is diminished by immersing the vessel in a large tank full of water, suggesting that part, at any rate, of the ionisation of the gas is due to a radiation which could penetrate the walls of the vessel, but which was stopped to an appreciable extent by the water. To explain the heating effect observed with radium, the absorption of this radiation by radium must be on an altogether different scale from its absorption by other metals. As no direct experiments have been made on radium, it is possible that this may be the case; it is not, however, what we should expect from the experiments which have been made on the absorption of this radiation by other metals, for these experiments have shown that the absorption depends solely upon the density of the absorbing substance, and not upon its chemical nature or physical state; if this law hold for radium, the absorption by it would be on the same scale as the absorption by lead or gold, and altogether too small to explain the observed effects. We are thus led to seek for some other explanation. I think that the absence of change in the radium has been assumed without sufficient justification; all that the experiments justify us in concluding is that the rate of change is not sufficiently rapid to be appreciable in a few months. There is, on the other hand, very strong evidence that the substances actually engaged in emitting these radiations can only keep up the process for a short time; then they die out, and the subsequent radiation is due to a different set of radiators. Take, for example, Becquerel's experiment when he precipitated barium from a radio-active solution containing uranium, and found that the radio-activity was transferred to the precipitate, the solution not being radio-active; after a time, however, the radio-active precipitate lost its radio-activity, while the solution of uranium regained its original vigour. The same thing is very strikingly shown by the remarkable and suggestive experiments made by Rutherford and Soddy on thorium; they separated ordinary radio-active thoria into two parts, transferring practically all the radio-activity to a body called by them thorium X, the mass of which was infinitesimal in comparison with that of the original thoria; the thorium X thus separated lost in a few days its radio-activity, while the original thoria in the same time again became radio-active. This seems as clear a proof as we could wish for that the radio-activity of a given set of molecules is not permanent. The same want of permanence is shown by the radio-active emanations from thorium and radium, and by the induced radio-activity exhibited by bodies which have been negatively electrified and exposed to these emanations or to the open air; in all these cases the radio-activity ceases after a few days. I have recently found that the water from deep wells in Cambridge contains a radio-active gas, and that this gas, after being liberated from the water, gradually loses its radio-activity; the radio-activity of polonium, too, is known not to be permanent.

The view that seems to me to be suggested by these results is that the atom of radium is not stable under all conditions, and that among the large number of atoms contained in any specimen of radium, there are a few which are in the condition in which stability ceases, and which pass into some other configuration, giving out as they do so a large quantity of energy. I may, perhaps, make my meaning clearer by considering a hypothetical case. Suppose that the atoms of a gas X become unstable when they possess an amount of kinetic energy 100 times, say, the average kinetic energy of the atoms at the temperature of the room. There would, according to the Maxwell-Boltzmann law of distribution, always be a few atoms in the gas possessing this amount of kinetic energy; these would by hypothesis break up; if in doing so they gave out a large amount of energy in the form of Becquerel radiation, the gas would be radio-active, and would continue to be so until all its atoms had passed through the phase in which they possessed enough energy to make them unstable; if this energy were 100 times the average energy it would probably take hundreds of thousands of years before the radio-activity of the gas was sensibly diminished. Now in the case of radium, just as in the gas, the atoms are not all in identical physical circumstances, and if there is any law of distribution like the Maxwell-Boltzmann law, there will, on the above hypothesis, be a very slow transformation of the atoms accompanied by a liberation of energy. In the hypothetical case we have taken the possession of a certain amount of kinetic energy as the criterion for instability; the argument will apply if any other test is taken.

It may be objected to this explanation that if the rate at which the atoms are being transformed is very slow, the energy liberated by the transformation of a given number of atoms must be very much greater than that set free when the same number of atoms are concerned in any known chemical combination. It must be remembered, however, that the changes contemplated on this hypothesis are of a different kind from those occurring in ordinary chemical combination. The changes we are considering are changes in the configuration of the atom, and it is possible that changes of this kind may be accompanied by the liberation of very large quantities of energy. Thus, taking the atomic weight of radium as 225, if the mass of the atom of radium were due to the presence in it of a large number of corpuscles, each carrying the charge of 3.4×10^{-10} electrostatic units of negative electricity, and if this charge of negative electricity were associated with an equal charge of positive, so as to make the atom electrically neutral, then if these positive and negative charges were separated by a distance of 10^{-8} cm., the intrinsic energy possessed by the atom would be so great that a diminution of it by 1 per cent. would be able to maintain the radiation from radium as measured by Curie for 30,000 years.

Another point to be noted is that the radiation from a concentrated mass of radium may possibly be very much greater than that from the same mass when disseminated through a large volume of pitch blende; for it is possible that the radiation from one atom may tend to put the surrounding atoms in the unstable state; if this were so, more atoms would in a given time pass from the one state to the other if they were placed so as to receive the radiation from their neighbours than if they were disseminated through a matrix which shielded each radium atom from the radiation given out by its neighbours.

J. J. Thomson.

ENTROPY.

The Thermodynamics of Heat Engines. By Sidney A. Reeve, Professor of Steam-Engineering at the Worcester Polytechnic Institute (U.S.A.). Pp. xiv+316+42. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 10*s.* 6*d.* net.

This is a very good specimen of that sort of book which is an amplification of the lecture notes of a professor who has carefully prepared problems for students. We may not always like the way in which he introduces the subject to his pupils, and we may say that it is unphilosophical and even cryptic, and sometimes too brilliant, but such comments are often due to the fact that his way happens not to be the usual way of presenting the subject. The way of Prof. Reeve probably suits his particular class of unscientific pupils very well. He uses terms in senses somewhat different from those in common use. He is absolutely correct in many statements with which we would willingly find as much fault as Macaulay did with those of Robert Montgomery. For example:—

"The universe is eternal. In the face of its steadfast continuity man's momentary existence and evanescent will are as cloud-wreaths against a mountain side."

We do not know why it should be thought necessary when an engineer is presenting the usual useful application of the known laws of thermodynamics that he should introduce it in thirty-six pages of this style of writing.

When the author comes to the actual problems which may be worked out by a simple application of the t,ϕ diagram, he is a fairly safe guide to the student, although here and there we should have liked him to point out on what assumptions he is working.

Perhaps readers of Nature will allow us to give a short description of the way in which even elementary engineering students are now able to solve what used to be considered very difficult problems.

We assume that at any instant a pound of stuff is all at the same pressure p and temperature t, and that it has a volume v. There is some law connecting p, v and t so that any two of these three will define the state of the stuff. During any infinitely small change of state, the stuff gives out mechanical energy or does work $p.dv$ if dv is its change of volume; let it receive the heat energy dH. Stating all energy in the same units, the net gain of energy by the stuff during the change is $dE = dH - p.dv$. This E is called the intrinsic energy of the stuff. We assume that there is no other kind of energy to be given to or taken from the stuff than heat and work. The first law of thermodynamics states that, if stuff is carried through a cyclic change and is brought back to its original state, the integral of dH is equal to the integral of $p.dv$, and E comes back to its original value. The integral of dH is not zero, the integral of the work $p.dv$ is not zero, but the integral of dE is zero. The gain of intrinsic energy in a closed cycle is zero. The second law of thermodynamics is that if we divide dH by t the absolute temperature (on a perfect gas thermometer) of the stuff and call dH/t a gain $d\phi$ of entropy, then the integral of $d\phi$ in a complete cycle is zero.

The mathematical statements of the first and second laws of thermodynamics are, therefore:—E and ϕ are properties of the stuff which are known if the state of the stuff is known. Or, dE and $d\phi$ are complete differentials.

Thus in any state of 1 lb. of stuff we know its

$$p, v, t, \text{E and } \phi,$$

and (except during change from solid to liquid, or liquid to vapour, when p and t are not independent) any two of these five enable all the others to be calculated. Hence, graphically, a diagram showing how any two of them alter, is a diagram which completely defines the changing stuff. This has been known ever since Rankine and Clausius discovered the second law of thermodynamics. It is owing to Mr. McFarlane Gray's persistency in advocating the use of the ϕ,t diagram in conjunction with the p,v diagram that engineering students are able so easily to work problems, especially in stuff which is in the liquid-vapour condition.

Since work is $p.dv$, the area of a p,v diagram re-

presents the work done in any small or large change of state. Since $dH = t.d\phi$, the area of a t,ϕ diagram represents the heat received. If students have the use of two blackboards on which they can, without trouble, show by the coordinates of a point the p and v or the t and ϕ of a pound of stuff, the whole thermodynamic conditions are known. If the state of a pound of any kind of stuff is given in any way, it is good to be able quickly to show it by a point either on the p,v or on the t,ϕ diagram. Therefore these blackboards have equi-pressure and equi-volume curves permanently marked upon them. Thus on a *water stuff* blackboard a student can mark in chalk, without any trouble, such points as these:—

(1) A pound of water steam, 80 per cent. water, 10 per cent. steam at a pressure of 80 lb. per square inch.

(2) A pound of water steam at 80 lb. per square inch, its volume being 3 cubic feet (the volume of the part which is water is neglected).

Or he can quickly work such exercises as these:—

(3) The stuff of (2) is cooled at constant volume to 30 lb. per square inch, show how it changes its state; find the heat abstracted.

(4) The stuff of (2) is expanded adiabatically, make a table showing its p and v at every instant and draw a p,v diagram showing the adiabatic expansion. State the dryness of the stuff at each point.

But why go on? It is evident that with such a board, with chalk and a sponge an experimenter can work the most interesting problems. He sees at once the thermodynamic inefficiency when heat is given to boiler feed water; the small thermodynamic efficiency of superheating; the wetting effect of expansion of dry steam; the drying effect of expansion on very wet steam; the heat given and the work done in any change of state.

We have found that this practice with blackboards leads to the most exact quantitative and practical knowledge of what goes on in heat engines. But the student must really state the answers as to heat and work exactly, the scales to which energies are represented being familiarly known. After a little practice, the ghostly quantity entropy gets to be as well known as electrical potential now is to experimenters—in 1868 it was merely a mathematical expression to most students, just as entropy now must remain to anybody who will not experiment.

An indicator diagram shows the pressure and the travel of the piston, and therefore we may say, the volume displaced behind the piston, but we do not call it a p,v diagram. Its value in enabling the indicated horse-power to be calculated, in telling how the valves and passages perform their duties, is, as we know, very great. But when we desire to use it in our study of the thermodynamics of the engine, we must first endeavour from our other measurements to find out how much stuff, water-steam or air or other gaseous mixture, is undergoing the changes of pressure and volume which are recorded. We must also know the actual volume of the stuff at every instant, and we get this by adding the volume of the clearance. We can now draw a p,v diagram, but it is not sufficiently noticed by students that it is only on certain assumptions being made that we can study the p,v diagram for a whole cycle of operations. For example, in a gas engine cylinder, we can draw the p,v diagram from the beginning of the compression, through the ignition and expansion parts until the exhaust valve opens, on the assumption that there has been no leakage past valves or piston. The p,v diagram of all the rest of the cycle is drawn on the assumption that something which is really occurring elsewhere is occurring in the cylinder itself. We consider that in the hands of elementary students the assumed p,v diagram for all other parts of the cycle may be very misleading. Unfortunately, it is seldom that one finds an author who is careful to explain these assumptions, which, when clearly understood, do enable most valuable calculations to be made. The idea underlying a p,v diagram is that any point shows the p and v of a certain quantity, say a pound, of the stuff. That is, it is all at a certain p. But during release, part of it is at one p and part at another, and during release, therefore, to speak of a p,v diagram is absurd. The assumption on which we usually proceed is that we shall let the area of what we call our p,v diagram represent the work done upon the actual piston.

Again, in a steam engine cylinder we can draw the real p,v diagram from cut off to release. All the rest of the cycle is drawn on the above assumption as to work. In drawing the t,ϕ diagram we assume that the stuff is all at the same temperature at any instant and every point on this diagram corresponds without ambiguity with a point on the p,v diagram, but it is on the assumption that we do actually know the weight of stuff we are dealing with. Given any p,v diagram for a given quantity of any kind of stuff, one, and only one, t,ϕ diagram can be drawn. The p,v diagram shows by its area the work done in every change, the other shows the heat given to the stuff in every change; the net area of any closed part of the one is equal to the net area (taking the same units for heat and work) of the corresponding closed part of the other.

It will be found that every engineer who has published speculations based on such diagrams has really kept in his recollection the assumptions on which they are drawn, but it seems a pity that for the sake of elementary students they should not specifically discuss these assumptions.

In refrigerating machines, in gas and oil engines, there is probably greater equality of temperature throughout the mass of stuff at each instant than there is in the water-steam of a steam engine cylinder. The state of things inside a steam engine cylinder is very complex on this account, but the p,v and t,ϕ diagrams, although based upon simple assumptions, really do lead us a long way in our study of what happens.

All engineering calculation is based on simple assumptions; the engineer knows that real problems are very much more complicated than any such assumptions suggest, and that experience and wisdom are needed by all men who are going to make use of such calculations. There are foolish men and foolish books which give students the notion that the simple assumption represents truly the real case, but the true en-

gineering student soon emancipates himself from such pedantry. The student who does not believe in the worth of any kind of calculation or consideration of what is going on in the cylinder is in a permanently worse state, however, than even the unemancipated pedant. Whether he reaches this position through disgust or because he has never made any attempt to compute, it may be premised that he is, or is destined to be, a child of Gibeon. When he says he is *designing* a new engine, he means that he is copying an old engine, introducing changes in detail which may or may not be for the worse. Consciousness of his degraded condition causes him to inveigh continually against all knowledge (or, as he calls it, *theory*); all power to compute beyond that which is possessed by the housekeeper. To the man who practises the use of the t,ϕ diagram, exercising his common sense, bringing all his other experience to bear, the thermodynamics of heat engines is revealed as it can be revealed in no other way. What is the p,v adiabatic for any kind of wet or dry or superheated steam with any initial pressure? How small is the thermodynamic value of superheating, and how great is its value in giving a dry cylinder? What is the exact benefit of using high pressure steam? In what directions are we to work in gas and oil engines, distinguishing between efficiency as to energy and efficiency as to total money values? Compare the commercial values of ammonium anhydride and air as the stuff to be used in refrigerating machinery. It is really wonderful to see how a man almost illiterate, innocent of algebra, can use his t,ϕ diagram of water-steam or air or ammonium anhydride, obtaining in a few minutes answers to problems which the mathematical engineers of twenty years ago spent days in solving. We know men who pet and fondle their slide rules, but the delight of these men is nothing to that of the men who make a daily companion of their t,ϕ diagram.

It is sometimes asked, During a change in which the p or t is not the same for the whole of the stuff; we can calculate the ϕ at the beginning and end, can we speak of its value in the intermediate states?

Now we know of no practical problem in which there is need to speak of ϕ in the intermediate states; ϕ, as carefully defined for the whole stuff, has no meaning during the change any more than p or v or t. In the case of a perfect gas allowed to expand freely without doing work, say, to twice its volume, the vessels being non-conducting, a true p,v diagram of the change cannot be imagined, and a true t,ϕ diagram cannot be imagined. If, however, we are allowed to assume, as is usual, that kinetic energy in a gas is heat, it is probable that if for every infinitely small portion of stuff we find the heat received by it dH at the temperature t, then dH/t for this small portion is a complete differential, and is its entropy, and the sum of all the entropies of all the small portions may be called the entropy of the whole stuff at each instant, although this is outside the definition. From this point of view we may speak of the entropy of the whole as changing continuously from the initial to the final condition. It was no doubt from this point of view that Clausius, in the only place in which he speaks of entropy of a system in which the temperature is not the same throughout, said "the entropy of the universe tends to a maximum." However, it would seem that it is dangerous to go outside the actual definition in our use of the word entropy for the whole of the stuff, and if so we had better say that, as we cannot speak of the p or t of the stuff during such a change as having any meaning, so we ought not to speak of its ϕ as having any meaning. Stuff carried cyclically through the same series of changes over and over again, like water in a steam engine or ammonium anhydride in a refrigerator, returns again and again to its original ϕ; passes every cycle through the same changes of ϕ.

Unpractical people, that is, people who dislike exact computation, occasionally exhibit annoyance when they are told that they cannot understand how to use the idea of entropy without a little study. This study may be mathematical or experimental, or better, both. If a non-mathematical person will accept in faith a few statements such as will enable him to perform exact computations with a t,ϕ diagram, it is astonishing how soon he can understand everything. This is how the late Mr. Willans was enabled to effect his great improvements in the steam engine. But the unpractical person who is not mathematical and refuses to experiment with diagrams makes the assumption that entropy is something he already knows about under some different name—it is some form of energy or a force or a pudding—and he writes great nonsense about teachers and writers on thermodynamics. If he is not quite ignorant he is more dangerous, for he speaks of the entropy of a quantity of heat in a furnace of a boiler, and traces the entropy of this heat as it passes to the condenser of a steam engine. Just as we say that two and three are not six, or that the world is not flat, so we say that to speak of the entropy of a quantity of heat is to talk nonsense exactly analogous with the volume of a quantity of work. We have exactly the same right to speak of the pressure or volume of a quantity of heat as of its entropy. We can easily speak of the total work obtainable in a perfect engine from a quantity of gas at high temperature in a furnace. We can also see how the energy received by it from fuel might have been received in a very much better way if it is to be made available for the doing of work in a perfect engine. All such problems are quite familiar to anyone who uses the t,ϕ diagram. It is Dr. Diesel's way of looking at this latter problem which is now so interesting. The heating and cooling of stuff must be performed by adiabatic compression and expansion. All heat must be given to the stuff at the highest temperature; all heat taken away at the lowest temperature. Not only is this quite clear to users of the t,ϕ diagram, but a thing of more importance the practical need for departure from these perfect thermodynamic conditions in actual engines.

Thermodynamic efficiency is one thing, the efficiency of which we speak when we think of the commercial cost of large cylinders doing on the whole only a small amount of useful work, that is another thing. It is an excellent exercise for a physics student to assume

that all energy is not equally valuable; thus, in an ordinary gas engine cycle, or that of the Diesel engine, let him assume that when energy has been given up to a crank shaft, and we now expend it in compressing the stuff in a pump, that each unit of it is five or ten times as *valuable* as mere heat energy; it is astonishing how much clearer his notions become concerning real practical efficiency of an engine. He is getting acquainted with the fact that all the problems of the engineer are much more complicated than those of the physicist or mathematician. JOHN PERRY.

VERTEBRATE MORPHOLOGY.

Vergleichende Anatomie der Wirbelthiere, mit Berücksichtigung der Wirbellosen. Von Carl Gegenbaur. Vol. ii. Pp. viii + 696. (Leipzig: Engelmann, 1901.) Price 20s.

THE aged master and founder of modern comparative anatomy has completed his life's task, and he has retired from the busy world. The results of half a century's active research and incessant thought are embodied in his "Vergleichende Anatomie der Wirbelthiere," of which the second volume deals with the alimentary and respiratory, vascular and urinogenital organs. The plan of the work now needs no further comment;[1] it is the same as that of the first volume. Short, extremely condensed accounts of invertebrate conditions form a kind of introduction to each chapter, which then deals with the Vertebrata to a very full extent, certainly much more fully than any other general and comprehensive book.

On the whole, the present volume is more up-to-date. Naturally so, since the bulk of it has been written within the last few years, and the author was able to dismiss for ever from his mind the vast amount of matter embodied in the first volume. The whole stupendous work, about 1500 closely printed pages and nearly 1000 text-figures, will give an everlasting impetus to vertebrate morphology. Not only is there deposited in it an enormous amount of anatomical descriptive detail, not only is it full of grandly conceived ideas, but new lines of further inquiry are laid down plainly, with cautioning against lurking pitfalls. It contains all the features of a text-book in the true sense of the word. It is a guide how to study morphology. And still this grand work, although hailed with delight on its first appearance, is not exactly liked or loved. On the contrary, many of its readers are disappointed. Those who expected that the book would be a revelation of the whole of animal morphology would do well to take to heart the author's repeatedly emphasised confession, "dass wir in den meisten Fragen erst am Anfang der Erkenntniss stehen." We, who know little, demand a final solution, where the master himself, after his own dissections and having criticised the conflicting statements of other workers, is satisfied with opening out entirely new vistas which widen the problem. Examples of this are the chapters dealing with the tongue, palate and epiglottis, wherein are embodied some of the author's latest original researches.

But there are several drawbacks which seriously detract from the value of the book as a readily accessible source of information; it is so difficult to understand. Every great writer has his own style, and that of our author is involved and heavy; there are hundreds of sentences the deep and sound sense of which does not reveal itself without much painful interpretation. This is felt and frequently admitted also in Germany. One of his foremost disciples, however, has written an indignant protest against this charge; the apologist points out that the subject-matter itself is difficult, that such a text-book must necessarily stand on another level than a novel, and that Goethe or Kant are likewise not always easy reading, &c.! Well, there are, and will be, many good morphologists and German scholars who will misunderstand our author, and that through no fault of their own. However serious and annoying, this defect of the book is a matter of form.

A much graver consideration is the following. The author begins a chapter with a continuous, needless to say logically coherent exposition of the structure, modifications, the phylo- and ontogenetic development of certain organs, and his own leading view appears clear and convincing until, without warning, he contradicts himself in what he has laid down previously, perhaps in some other chapter. Or worse still, there follow long passages in small print containing another hypothesis or new facts the merits of which are put so forcibly that the reader cannot doubt that this must, after all, be the view preferred by the author. In many of these cases only one interpretation can be right, but the text goes on as if no amendment had been carried. Frequently this upsetting mode of treatment is obviously due to more recent additions or interpolations. Of course, a fair-minded author gives every tenable hypothesis, and if he then states that the solution is not yet final, no more remains to be said. This our author does often, even as a rule, but not always, and, therefore, the exceptions are all the more jarring. *Jurare in verba magistri* may be a sign of unscientific weakness or laziness, but we have a right to learn the views of an acknowledged master.

But let us proceed from generalisations to crucial points.

Origin of Vertebrata.—The transformation of the anterior cephalic portion of the alimentary canal into a respiratory chamber is predominant in, and typical of, the Vertebrata. Resemblances in the formation of such a chamber, first and faintly indicated in Cephalodiscus, carried further in Enteropneusta and Tunicata, do not mean near relationship with the Vertebrata. Direct transitional stages are still unknown, perhaps because the creatures concerned have died out. Mouth and arms being secondary features indicate that the Vertebrata have a long ancestral history. Although Amphioxus resembles Tunicates in many respects (respiratory chamber, peribranchial cavity, hypophysis, &c.), the metamerism of its body is a feature of such importance that it forbids any

[1] See review of vol. i., NATURE, December, 1898.

closer connection of these two groups (p. 25). Thus we are told categorically that we need not look any further in this direction for the vertebrate ancestors. But in spite of this, on p. 338, the epithelial lining of the bloodvessels is spoken of "als ein erst den Tunicaten und von da den Vertebraten gewordener Erwerb." The remark on p. 25—that the origin of the Vertebrata is not quite strange to the Invertebrata, since the organisation of the former exhibits nothing absolutely new, nothing which does not crop up in some one of the other phyla—sounds rather flat, and conveys little comfort to him who is anxious to learn what the greatest authority has to say about their descent.

Lungs and Airbladders, p. 256.—Certain Selachians possess a dorsal blindsac opening into the œsophagus, perhaps the forerunner of the airbladder of other fishes. Since this diverticulum exists in Selachians only during their early life and vanishes in the adult,

"wird es als rudimentaeres Organ zu deuten sein, wobei nur fraglich bleibt, wie der ausgebildete Zustand sich verhielt, und ob es je einen solchen besessen hat."

Are here not mixed up the two opposites rudimentary and vestigial? If this organ never was in a complete, functional condition, it would be a rudiment in the sense of incipient evolution. But our author can only mean vestige or remnant.

Concerning the question of the homology of airbladders and lungs, a view still frequently advocated, we are told clearly, on p. 216, that

"from the low stage of the future lungs are derived other organs which do not yet have a respiratory function, namely, the so-called airbladders of the fishes. Consequently we do not meet with the lungs as such from their first beginning, but as air-receiving organs of other significance. Only gradually they become capable of competing with the primary respiratory organs (the gills) and are thereby turned into lungs."

But on p. 256 we are informed, upon the ground of want of proofs of the change of airbladders into lungs, that more likely the airbladders and lungs are akin to each other only in so far as both are evaginations of the gut, but that both have started very early upon opposite roads. In other words, the text is flatly contradicted by the small-printed later addition.

Gills.—On p. 239, the inner gills of the Anura are properly derived from their outer gills, a modification which has been studied by Maurer and others. On the next page, however, the outer gills of the Anura are derived, à la Boas, from the true inner gills of fishes, and on p. 341 we are told that the former, first, derivation means a gap in comparison with fishes. Of course there would be a gap, since the two statements, the first correct, the second a baseless assumption, are absolutely contradictory. This muddle could not have happened unless the small type of pp. 240-241 was a later addition to the text.

Vascular System, pp. 337-339.—The participation of the endoderm in the formation of the heart of Amphioxus is certain. Very valuable is the fact that the endoderm contributes to the vascular system, heart and vessels of certain Elasmobranchs, but it is gradually superseded by the mesoderm. It is doubtful whether the case of entirely mesodermal formation is a reversion to the original condition. Since the endodermal origin stands in opposition to what happens in almost all the bilateral invertebrates, we conclude that the change took place already in the Tunicata, viz. that endodermal growth has been acquired by them, whence the Vertebrata have taken it over. Now, having had to conclude that the endodermal origin of the vascular system of Tunicata and Vertebrata is a secondary feature, which is still preserved in but a few cases, the question arises whether the mesodermal origin is to be explained by a reversion to the original condition or whether it is (p. 339) once more (wiederum) a cænogenetic feature. We desist from answering these questions,

"da in den Thatsachen nichts geaendert wird, und durch Caenogenese auch etwas Altes entstehen kann, nach den Beziehungen die alt und neu besitzen."

He who understands the above sentence, to the exclusion of doubt, will be able to translate it.

Could the author not apply to the solution of the discrepancy the same principle of the suggestion which he makes on p. 416, apropos of

"the origin of the lymph-follicles reveals the lymph-cells as derivations of the endoderm. The primitive condition is lost in the Placentalia, not because the endoderm has handed over its function to other tissues, but because the latter have received their endodermal share at a much earlier ontogenetic period"?

Heart, p. 345.—The heart of reptiles, birds and mammals passes temporarily through the stage of a double tube. On p. 345 this is explained as an undoubtedly secondary feature, due to a special adaptation to nutritive arrangements, namely, the accumulation of foodyolk, on or in the wall of the gut. In the Mammalia the double anlage still occurs, in spite of the loss of the yolk. This is certainly an ingenious and possibly correct explanation, but the reader will miss any allusion to Elasmobranchs, with their unpaired heart-tube and great mass of yolk. He may further wonder from which class of animals the mammals have taken over this feature, if, as our author contends repeatedly, the reptiles are to be excluded from the mammalian line of descent.

Coecum and Vermiform Appendix.—On p. 171, speaking of the end-gut, he emphasises his former suggestion that the finger-shaped gland of Selachians is the forerunner of the cœcum; a complex of glands which pour their secretion by one duct into what marks the upper end of the end-gut. Such glands must necessarily have started from the endoderm, but on p. 174 we find the following perplexing statement:—

"The independence of the cœcum is (in Iguana) most strongly shown, and thereby we come to that organ which the Selachians possess as the finger-shaped gland, originally foreign to the gut-wall, but raised to permanent value by the connection with the latter."

As here expressed, this can only mean that once upon a time there existed a fluid-secreting gland in

the neighbourhood of the gut, and which later on, becoming connected with the gut, laid the foundation of an important organ, the cœcum.

Excretory Organs, p. 437.—The author favours Boveri's hypothesis of the evolution of the archinephric duct, but with an almost fundamental modification. However, this explanation, being inapplicable to Cyclostomes, leads to new difficulties and further doubts, which partly undo what has been elaborated just previously. H. Gadow.

THE WORK OF MARIGNAC.

Œuvres complètes de J. C. Galissard de Marignac. Tome ii., 1860–1887. Pp. 839. (Paris: Masson and Co., n.d.)

It is by no means an easy task to give an intelligible account of the labours of such an industrious and versatile worker as Marignac was. An outline of his life, written by M. Ador, his son-in-law, who edits the two large volumes of his republished work, has already been noticed in these columns. It now remains to deal with his researches, of which only a sketch has previously been given.

The three main lines of investigation treat of (1) the rare metals of their compounds, (2) crystallographic measurements, and (3) thermal chemistry. Under the first heading, we find memoirs on beryllium, lanthanum, didymium, yttrium, erbium, niobium, tantalum, "ilmenium," zirconium, mosandrum, and ytterbium, the last a discovery of his own. The final article in the book, published in 1887, is a criticism of Sir William Crookes's paper "On the Genesis of the Elements"; Marignac is not disposed to accept the interpretation which Crookes places on the different spectra of successive fractions of "yttrium," viz., that a gradual separation of an element into parts endowed with different properties has taken place; he rather inclines to attribute the varying spectra to the accumulation at each end of fractions of impurities, each of which has the power of profoundly influencing the spectrum of the real yttrium.

The equivalents of no fewer than twenty-eight elements were determined by Marignac; and at the end of the book a comparison is made between the values found by him and the table of the International Committee of 1903. The correspondence between the two is very striking; indeed, in no fewer than fourteen instances, the numbers are almost identical. It is strange, however, that Stas found for the atomic weight of iodine the number 126.85, while Marignac agrees more nearly with later determinations by Ladenburg and by Scott. In stating his results, Marignac is always modest. He writes:—

"Je puis bien reconnaître, après avoir étudié le beau travail de ce savant, qu'il a apporté, dans ses expériences, des soins infiniment plus minutieux que ceux que j'avais cru devoir prendre."

Nevertheless, in almost all cases, the agreement with Stas is a very close one. He is by no means convinced that Prout's hypothesis is put out of court by Stas's researches; he draws attention to the fact that while the mean variation from whole numbers of the atomic weights determined by Stas should be about 0.5, it is only 0.103, even if chlorine be included; and if chlorine be rejected, it is reduced to 0.068.

From time to time, Marignac wrote criticisms of notable papers recently published; and in many instances he repeated the work of the authors. His remarks were always gentle and kindly, hence he never was drawn into controversy. Yet he bore his share in attempting to solve the questions of his day; he published many papers relating to dissociation; the most noticeable deals with the specific heats of gaseous ammonium chloride, mercuric chloride, and sulphuric acid, and the heats of volatilisation of these bodies. The latter are naturally high, for they include the heat of dissociation. Marignac's criticisms are, however, sometimes a little naïve; for example, after drawing attention to Andrews's and Tait's observation that the volume of ozonised oxygen is increased permanently by raising its temperature to 230°, he remarks:—

"Or, une condensation aussi considérable que celle qui résulterait des expériences de MM. Andrews et Tait eut été un fait trop saillant et trop important pour échapper à ces habiles chimistes (MM. Fremy et Becquerel) ou qu'ils n'en fissent pas mention."

If this species of argument were permitted, the progress of science would be slow.

Marignac's crystallographic measurements are very numerous, and were evidently made with the greatest care; they should form a valuable storehouse of facts, when our knowledge of the relation between the forms of matter and its constitution has been further developed.

Among his researches on thermal chemistry, besides those relating to anomalous vapour-densities, Marignac devoted much time to the investigation of the specific heats, densities, and expansion of solutions. Like all his work, it is careful and exact, but led to no important conclusions.

Enough has been said to give the reader an idea of the enormous productivity of Marignac. In his own field, that of the rare earths, he is probably unsurpassed as an investigator, and in issuing this collection of his memoirs, M. Ador has erected to him a monument "aere perennius." W. R.

IRRIGATION IN THE WESTERN STATES OF AMERICA.

Irrigation Institutions. A Discussion of the Economic and Legal Questions created by the Growth of Irrigated Agriculture in the West. By Elwood Mead, C.E. Pp. xi+392. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 5s. net.

This work was originally prepared for a course of lectures on the institutions and practice of irrigation for the University of California. The author is of opinion that the land in the United States that has hitherto been relied on to meet the demands of the nation's growth will not much longer be available for this purpose, so rapid has been the increase [illegible]

population during the last few years. It is anticipated that at the end of the next half century there will be 200 million people to feed. It has for some time past been recognised that the arid regions of the West, at the foot of the Rocky Mountains, consisting of enormous areas of barren sands broken only by patches of yuccas and sage bushes, becomes, if irrigated, capable of growing crops of all kinds and in the greatest luxuriance. Already where irrigation has been applied, the traveller almost suddenly passes from a desolate and an apparently worthless region to a land of plenty, and is confronted by orchards and gardens which resemble the century old creations of France and Italy, with homes rivalling in taste and convenience those of the eastern States. The climate, though arid, is remarkably healthy, the heat of the southern summers and the cold of the northern winters being mitigated by the dryness of the atmosphere. The mountains and valleys of this district are recognised as natural sanitaria, to which thousands of persons resort in order to live. The arid land, when irrigated, is capable of producing crops worth 20*l.* an acre. Oranges and grapes grow and ripen abundantly, and in Southern California an orange grove of twenty acres constitutes an estate.

The value of the land for raising crops when irrigated became first recognised by the flourishing condition of the colony established by Horace Greely in Colorado, and after his success numerous irrigation schemes were set on foot, both by single settlers and companies. The first step in the change from sage bush desert to fields of grain is the construction of a ditch by the small holder, or of a canal which shall be large enough to water several farms. These canals, in some cases, are large enough to supply from five hundred to a thousand eighty acre farms. The water is supplied to the farmers in fixed quantities, measured either by the miner's inch or the cubic foot, being the volume of water that will flow through an inch or foot square orifice under a designated pressure; or else by the acre foot, being the quantity required to cover an acre to a depth of one foot. The price paid for the water varies according to the locality and the cost of the works.

When the rivers and streams carried a surplus, water was diverted with lavish prodigality, and irrigators gave scant heed to their respective rights because, so long as each had all he needed, he was satisfied. When, however, irrigated agriculture became an assured success, and the area of the irrigated farms increased, innumerable quarrels and law suits as to water rights ensued, and as, according to the author's estimate, there is only a sufficient supply of water to irrigate one-tenth of the arid West, the right to obtain this will be guarded with greater jealousy as time goes on. The laws in the different States as to these rights vary considerably, and are set out with much detail by the author. This, together with the practical information given as to irrigation, will render this book of very great service to those engaged either as settlers on the irrigated lands or to hydraulic engineers engaged in laying out irrigation works.

OUR BOOK SHELF.

Algebra. Part i. By Kaliprasanna Chottoraj. Pp. vi+482. (Calcutta: The City Book Society, 1903.)

THIS book is "an elementary treatise on algebra intended for use in Indian high schools." "Each rule and each process are followed by a well-graduated and sufficiently large collection of examples." These quotations from the preface serve to characterise the book. It is intended for beginners, and includes the theory of indices, and proportion, but not quadratic equations. The book is too full of rules and processes, and the student is in danger of losing his grasp of the fundamental ideas through the bewildering number of special methods, and may be led to think that he must remember the many rules and artifices which can only be acquired by practice and experience. Thus, for instance, under the heading of the resolution of x^2+ax+b into factors, we find a first method, a second method, followed by two important hints and forty-five examples; then ax^2+bx+c is treated on the same lines and at the same length.

The explanations of fundamental principles are sound and clear, and seem designed to meet every conceivable difficulty, but there is a tendency to lay stress on unessential features and mere details of presentation. As an instance of exactness, it is shown how the lowest common multiple need not be the least in an arithmetical sense. We are glad to see a whole page devoted to the distinction between an equation and an identity.

An attempt is made to define the order of the operations in an expression such as $a \div b \times c$. This can only lead to confusion and mistake. The use of brackets should be taught from the beginning.

The book is poorly printed, but of a convenient size, and will doubtless prove useful to those for whom it is intended. R. W. H. T. H.

Practical Chemistry and Physics. By J. Young, A.R.C.S., F.C.S. Pp. 108. (Woolwich: Cattermole, 1903.)

THE space allotted to "physics" is so very limited (9 pages out of 108) that the book may be considered as one on practical chemistry.

As a laboratory guide to chemical analysis there is little to distinguish it from many others dealing with the same subject. The individual reactions for the metals and acids are followed by analytical tables and a few exercises in gravimetric and volumetric analysis. A page is usefully devoted to the detection of impurities in common reagents.

The utility of a book of this kind depends in the first place on the student's previous training in practical chemistry, for it would be out of the question to put a beginner through a course which deals almost exclusively with inorganic analysis; in the second place, it depends on the amount of supervision exercised by the demonstrator, for there are neither drawings of apparatus nor details of manipulation. Granted the necessary training and supervision, one is nevertheless led to suspect from observations dropped here and there that it is not a quickening spirit of philosophic inquiry which pervades the book, but the heavy atmosphere of the examination room. "The test is too delicate for ordinary use." "Be careful always to add excess of the group reagent. Any less is quite useless; the ppt. not only fails to come, but afterwards appears in the wrong place, besides giving rise to other complications." "When the number of bases known to be present has been found, the analysis can be stopped."

A reminiscence of the old stock question of the

Science and Art elementary paper is contained on p. 73 under the heading of "How to construct chemical equations." The expression "two thicknesses of blue glass" might be more explicit, and the same may be said of the term "injurious" applied to an excess of barium chloride. Many of the pages are unnumbered, and there are numerous misprints. J. B. C.

Elements of Physics. By Ernest J. Andrews and H. N. Howland; to which is added a Manual of Experiments. Pp. xi+386+53. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 6*s.*

The aim of the writers has been to present an account of physics suitable for secondary schools. With this aim in view, they have avoided everything of a purely academic character—with the exception of "little bits of history" which they make a point of inserting. The book is of a very elementary character, and is almost completely free from any mathematics except the simplest arithmetic. More attention is paid to a delivery of the facts with which a pupil is expected to be acquainted than with formal proofs of the relations between them. The authors' methods may be indicated by the constant recurrence of the two phrases "it is evident" and "just as." The latter phrase shows the reliance placed on the method of analogy; the former phrase sometimes means *it is easily proved by simple experiments*—and suitable experiments are then described; sometimes it appears to be used merely to help over a difficult point. Great emphasis is laid on a pupil learning a thing by observation, and this is as it should be. An adequate course of introductory experiments is given in the "Manual."

In general, the explanations given are clear and sufficiently accurate. It is true that the man who is clothed with the love of accuracy as with a garment will not take much pleasure therein. But there is a rapidly growing class of students—the product of county scholarships, &c.—who, owing to imperfect mental training, require knowledge to be served up in a simple if even somewhat loose way; and these requirements deserve to be satisfied.

In a few places there are unfortunate slips. The reference to "permeability" on p. 183 is quite misleading—it is confused with "retentivity." Again, in connection with the liquefaction of gases, it is explained how a little liquid air may liquefy a lot; this savours of the monthly magazines. These misconceptions should be cleared up in a future edition.

First Steps in Photo-Micrography. By F. Martin Duncan. Pp. 104. (London: Hazell, Watson and Viney, Ltd., 1902.) Price 1*s.* net.

This little work is intended, as its title implies, to be a guide for those who are beginners in a fascinating branch of photography. It is avowedly written for photographers, and not for microscopists, so that much that is passed over may be excused. The apparatus stated to be necessary is such that good work may be accomplished even with moderately high powers.

The tendency has been of late to advise beginners to attempt some photomicrographic work with the most meagre appliances, thereby increasing their difficulties at the beginning.

It is satisfactory to note that in this little book simple yet efficient appliances are advised. The portion devoted to the illumination of objects, perhaps the most important part of the whole subject, is treated all too briefly, but in other respects the book may be recommended to those who are commencing photomicrography, as a useful guide which will materially assist them in their earliest efforts.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Radio-active Gas from Well Water.

I have recently found that water from deep wells in Cambridge contains a radio-active gas, and I am anxious to see whether water from other sources possesses the same property. I should be greatly obliged if any of your readers who have access to deep level water would fill a clean two-gallon can with it and forward it to the Cavendish Laboratory. I should, of course, pay the carriage and return the can. I may say that I have already had samples of water from Birmingham and Ipswich, each of which contained the gas. J. J. Thomson.

Cavendish Laboratory, Cambridge, April 25.

Can Dogs Reason?

Dr. Hill has recently asked the question, "Can dogs reason?" The following analogy has always appeared to me to be a sufficient reply. In ordinary circumstances, few human beings make use of their sense of smell; to excite it, the odour must be fairly strong, and also unusual. It may be regarded as probable that few dogs make habitual use of any power of inference, but have only vague sensory impressions, to which an almost automatic response is given. Yet under sufficient stimulus, they may perform acts involving an exertion of a considerable amount of "thought." Whereas, then, dogs rarely "think," but frequently make use of their delicate sense of smell, human beings seldom make use of that sense, but constantly exercise their reasoning faculties.

Again, is not the opening of a box somewhat akin to the exercise of an inventive faculty? Teach a man how to operate a complicated machine of which he does not understand the mechanism, and it may be doubted whether he will connect the process of setting it in motion with some desire to gain an advantage which is not obviously attained by doing so.

I am tempted to describe an occurrence which reveals in a dog which I have at present the possession of two rather rare qualities of mind for a dog. One is the accumulation of brightly coloured objects. This dog sleeps on a mat in a basket. On taking out the mat to clean it, a strange collection of articles is generally neatly arranged below it; I remember, for instance, large pieces of red sealing-wax attached to strings, a comb, a piece of whalebone, a Brussels sprout, some lumps of coal showing pyrites, a polished dry rib bone, some kindling sticks with resin, &c. These objects had not been gnawed, but merely placed under the mat as valued possessions.

Again, this dog has a keen sense of a joke. Some days ago, a small dog with a loose chain was wandering in the garden. Its owner came out and called it. My dog caught the chain, dragged the little dog away, and waited events. As soon as the owner approached, the small dog was dragged out of reach, and it was not until after a long chase that the little dog was captured. These small incidents show, I think, that it is as impossible to classify all dogs together as it is to classify human beings; their minds naturally run in very different directions, and, just as there are inventive or artistic men, so dogs may show leanings towards special developments of their minds. William Ramsay.

Bullfinch and Canary.

That a bullfinch can be trained to pipe a whole tune, or more, to perfection, that is to say, do it, so far as intonation and rhythm are concerned, as well as any skilled musician, everybody knows. It is also a fact, though perhaps less common, that a canary, placed in an adjoining room and hearing the tune of such a piping bullfinch over and over again, may, quite by himself, *i.e.* without being trained for it, acquire the same accomplishment to the minutest detail.

An experience, however, which I have had during a

recent visit to Germany has so greatly impressed my friend Prof. Hubrecht of Utrecht, to whom I told it, that I venture to think you will find it of sufficient interest to be laid before your readers.

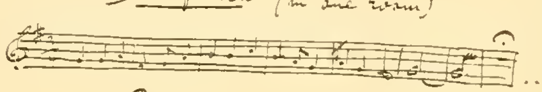
My sister, Frau Prof. Grosse of Brunswick, possesses an old bullfinch which pipes, among other tunes, "God Save the King" beautifully, even embellishing it now and then with some charming little gracenotes. For some time he was the only bird in the house, until, about a year ago, my sister received the present of a canary bird, a lovely but untrained songster, singing, as they say in Germany, "as his beak was grown."

The cages containing the two birds stood in two adjoining rooms. At first one of the birds would be silent when the other was singing. Gradually however the young canary bird commenced to imitate the tune of the bullfinch, trying more and more of it at a time, until after nearly a year's study he had completely mastered it, and could pipe it quite independently by himself. As I said before, this, in a canary bird, though a rare accomplishment, is nothing very extraordinary or unheard of.

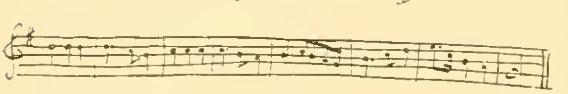
Now, however, I come to my point. What I am going to relate seems to me so wonderful that I should consider it absolutely incredible had I not with my own ears heard it, not once, but dozens of times within the few days of my visit.

When the bullfinch, as sometimes happened, would, after the first half of the tune, stop a little longer than the rhythm of the melody warranted, *the canary would take up the tune where the bullfinch had stopped*, and properly finish it. This, then, is what I heard:—

Bullfinch (in one room)



Canary (in another)



I should be glad to read in a further issue of your paper whether you share my astonishment, or if any of your readers can perhaps recall, or have ever heard of, a similar experience. GEORGE HENSCHEL.

Kensington, April.

Mendel's Principles of Heredity in Mice.

IN NATURE of March 19 Mr. Bateson refused to discuss the eye-colour of Mr. Darbishire's mice as a simple character, separable from coat-colour. He then treated Mr. Darbishire's results as dependent on gametes of two kinds; one, G, bearing the characters "white coat and pink eye," the other, G′, bearing "colour in the coat and pink eye." The hybrids resulting from the cross were said to be of constitution GG′, and their offspring were represented, in constitution and in relative frequency, by

$$GG + 2GG' + G'G'.$$

Hybrids are here represented as producing gametes of two kinds only, each kind like that of one pure race; eye-colour and coat-colour are transmitted together in one unresolved "allelomorph." The mice in any one of the three groups are said to be formed from similar pairs of gametes, and they should themselves be similar; but they are not. The colour in the coat of a mouse GG′ may be yellow, or some shade of wild-colour, or black; that of a mouse G′G′ may be yellow, fawn, or "lilac."

In NATURE of April 23 Mr. Bateson abandons his first formula; he now says (1) that more than two kinds of gametes take part in the first crosses, since the gametes of one or both pure races are heterogeneous; (2) that coat-colour is split into simpler elements when the hybrids form gametes. The heterogeneity of gametes in two races, both of which breed true, while one has been declared by Mr. Bateson to be universally recessive, is a doctrine too amazing for brief treatment; I therefore consider only the second of the new assumptions.

The hypothesis of March 19, invoking only two kinds of gametes, supposes that one out of every four offspring of hybrids will be a recessive albino, and this is not contradicted by the facts: but the hypothesis regards black and yellow coat-colour as produced by identical pairs of gametes. The new hypothesis provides different gametic elements for the black and for the yellow mice, but it reduces the number of "recessive" albinos among the offspring of hybrids to a *maximum* of one in *nine*. The two "Mendelian predictions" which Mr. Bateson has so far uttered *ex post facto* are mutually contradictory; with which of them is the inheritance of coat-colour "in punctilious agreement"?

Oxford, April 24. W. F. R. WELDON.

The Discovery of Japan.

FROM a review in NATURE of November 13, 1902 (vol. lxvii. p. 28), I gather Herr Hans Haas, like many other writers on Japan, considers Ser Marco Polo the first who brought any news of Japan to the west. In this connection, it will be interesting to note that in his "Six Voyages," Paris, 1676, Tavernier tries to identify a local name of the classic geographers, *Jabadi*, if I remember correctly, with the ancient vernacular designation of the empire, *Yamato*, or rather with its Chinese rendering, *Yamadai* or *Jabatai*.

Whether this identity be true or not, it is almost certain that Japan was well known to the mediæval Arabs much prior to Marco Polo. In a French translation of the "Voyages of the Two Arabs in the Ninth Century," an island near China is mentioned the inhabitants of which used to send a tribute to the latter, in the firm belief that it would make their own country peaceful. This island seems to point to Japan, the story being apparently a version of the legend, recorded in Wang Chung's "Lun Hang," first century A.D., that under Ching-Wang of the Chau dynasty (*c.* 1100 B.C.), China enjoyed such an extraordinary peace that it caused even the winds and waves in the neighbouring States to be perfectly calm, on which account the people of Lacs gave him thanks by their envoys, who reached the capital after several years' journey, and the Japanese made him presents of the Salty Herb (now supposed to mean the *Angelica Kiusiana*, Maximowicz). The "Second Annals of Japan" mentions several Arabs, including women, passing into or becoming settled in Japan during the eighth and ninth centuries. This is no wonder, for, in those ages, China under the grand dynasty of Tang was so prosperous and powerful that nearly all Asiatic peoples of significance vied in asking her favours, and they saw each other very frequently in that empire; besides, doubtless there were many Japanese who passed through China into the lands then called her territories or tributaries; thus, Twan Ching-Shih, in his "Miscellany," written ninth century A.D., speaks of his meeting with a Japanese priest, who came back from his travels in India, where he witnessed the figures of the famous Chinese pilgrim, Hiuen-Tsiang, revered in the Buddhist churches. Indeed, the "Second Annals" relates how, in the year 753 A.D., the Japanese ambassador was successful in a dispute with the Arabian about the first seat of honour on occasion of a state banquet on the New Year's Day. Add to these, in the "Hokuhen Zuihitsu," written eighteenth century, it is argued that in the Middle Ages there were mutual acquaintances between the Japanese and the Persians.

When we see in the sixteenth and seventeenth centuries (in part) the Spaniards and Portuguese flourishing in the Japanese ports under the native appellation *Namban*, or South Barbarians, it is very striking to find in a memoir evidently written in the fifteenth century, entitled "The Successions of Governors of a County in Wakasa" (in Hanawa's "Collection," ed. 1894, p. 375), the following passage:—

"June 22, 1408. A vessel of the Nambans arrived (in the province of Wakasa). Their emperor's name is Arekishinkei, and the envoy's Mongwan-hon-a. His Majesty's presents to the Japanese emperor were a living black elephant, a mountain-horse (*sic*), two pairs respectively of the peafowl and parrots, and various other articles. The ship was wrecked by a storm, and stranded on November 18, but, after being reconstructed, started for China on October 1, 1409."

This took place just 135 years before the advent of the Portuguese deserters Herr Haas describes as the first Europeans reaching Japan; and if so, what were these "Nambans" of the years 1407–8, the first instance, so far as I know, of the name in the Japanese records of this sort?

In the same review, the writer, talking about Xavier's labours, says:—

"What would be interesting and instructive to know would be what the Japanese, especially the Buddhists and Confucianist scholars, thought of his doctrines. No hint has come down to us—perhaps they took no thought of a strange religion that seemed of no importance."

As he expresses it at the same time, Xavier's stay was too short to qualify him to make his dogmatic teaching in its utmost expression; but one must not conclude thereby that in the same century Japan was totally destitute of the native scholars of repute taking interest in the subject of Christianity. Thus we read in a eulogy on Master Seigwa (1561–1619), the greatest of all Confucianists of that age, that he was thoroughly learned not only in all Japanese and Chinese literatures, but, moreover, "as well in the books of the Buddhists in India as in the doctrines of Jesus Christ of the South Barbarians" (Oota, "Ichiwa Ichigen," ed. 1885, tom. xix. fol. 19, *b*).

As the native documents and treatises of any concern to Christianity were well-nigh annihilated under the most rigorous inquisitions, which were mainly incurred by the so-called South Barbarians intermeddling with the political affairs of the country, and which that religion continued to undergo during the two centuries of the Tokugawa Shôgunacy, practically no hint has come down to us of what the native scholars thought about it before the persecution began. From what are left dispersed in their works, however, we may be fair in judging that most of the intelligent Japanese, then and directly after, descried in the tenets and rituals of Roman Catholicism nothing but an especial form of Buddhism. To the Europeans, Nobunaga's dictum on its toleration is well known—"While there exist so many sects already, why do we not let this sect stand?" Kumazawa Ryôkai (1619–91), the renowned Confucianist reformer in politics, calls the creed simply Southern Buddhism, *i.e.* Buddhism of the South Barbarians. Later, Arai Hakuseki (1657–1725), after repeatedly giving ear to the Roman missionary, J. B. Sidoti, is said to have remarked upon the subject, "His doctrine is as absurd as Buddhism, they differing from one another only in the points of their terminology" (Amenomori's "Adversaria," ed. 1892, vol. x. p. 86). Parallel to these, I remember I have read in a letter of Xavier's contained in Ramusio's "Viaggi e Naviationi" a passage implying his recognition of some Christian essence in the Buddhist dogmas then current in Japan.

As I recollect there was in a back number of NATURE a certain though very brief reference to a Life of J. B. Sidoti, it will be *apropos* of this letter to give a few facts relating to him, which, I think, are not so well known now among Christians as they ought to be. Arai Hakuseki, mentioned above, was a man of singular parts, extensively erudite, notorious in poetry even in China, very active in politics of the court at Yedo, and nowadays nobody denies him the honour of the first introducer of the western science into the Land of the Rising Sun. This innovation, however, was simply the result of his official interviews with that devoted but unfortunate missionary in 1709 A.D. Sidoti professes to have made himself adept in the Japanese language at Rome, but after all his acquirements appear to have been too limited to make him speak freely in it. So Hakuseki made every effort in his brain to secure from him accurate information on subjects of the regions, then perfectly unknown to the Japanese, through a Dutchman's interpretation, observing on the difficulties of the task at the outset, "Still is it reasonable to suppose that all this stranger's words are nothing but a shrike's shrieks?" The results of these conversations were the two works "Choice Reviews of a Foreigner's Tales" and "A Memoir on the Western Ocean," which formed the principal cause of the eighth Shôgun's edict to tolerate the reading of the European books pertaining to science and arts, the *sine quâ non* of their wholesale importation in these present days. That all the conduct of Sidoti greatly affected Japanese minds, in spite of their hatred of his creed, is borne out by a letter he wrote in a prison, whereby he petitioned the authority to chain him tightly in cold winter nights, in order to let the miserable watchmen about him enjoy their sleep at ease (see Oota, *op. cit.*). Immediately after Hakuseki's remark on his religion quoted above, this passage follows:—"But his personality was so uncommon that it makes me ever unable to forget him!" And it will be greatly gratifying and edifying to the modern Christians to reflect upon how powerful the unparalleled morality of this single, forlorn missionary was after his death, in effecting the reopening of the doors, which his nominal brethren, the very worthy "South Barbarians," had caused the Japanese to shut against themselves. In fact, Yuasa's "Miscellany from a Literary Society" tells us, "Hakuseki used to say all Sidoti's deportments convinced him in the belief that even the Five Virtues[1] of our Sage were no more than what that missionary daily carried himself with"; an unexampled encomium uttered on a Christian by the followers of the great Chinese philosopher!

KUMAGUSU MINAKATA.

Mount Nachi, Kii, Japan, March 10.

Sir O Lodge and the Conservation of Energy.

THE utterances of many men of science as to the doctrine of the conservation of energy betray a tendency to exaggerate the importance of the position of this principle in the general scheme of physical science. It appears sometimes to be forgotten that the principle of energy, if applied to even the simplest dynamical system which is possessed of more than one degree of freedom, is, taken by itself, wholly insufficient for the determination of the motion of such system. Although the principle has been of inestimable value as regulative of the relations between the different forms of molar, molecular, and corpuscular energy which the state of our knowledge compels us to distinguish, it is nevertheless true that in an ultimate dynamical formulation of physical phenomena, the principle of energy descends to the rank of being one integral only of the dynamical equations of a system, a knowledge of the other integrals being indispensable for the complete determination of the motions of the system.

This tendency to exaggeration is illustrated in a very striking manner in the interesting paper by Sir O. Lodge on "Interaction between the Mental and the Material Aspects of Things" (see NATURE, April 23, p. 595). Sir O. Lodge, in discussing the question whether the assumption of a direct action of life upon matter is consistent with physical laws, advances the theory that, although life cannot generate mechanical energy, it can exert guiding mechanical forces which do no work on matter. Sir O. Lodge appears to think that by restricting the action of the psychical on the physical in this way, he has suggested a compromise which ought to satisfy the supporters of naturalism whilst it at the same time leaves sufficient play for the action of the psychical.

The really fundamental issue between the advocates of thorough-going naturalism and their opponents is at bottom the following:—Can the human body, or the physical world including living organisms, be rightly regarded as theoretically completely representable as a dynamical system, in such a manner that the whole of the motions of the system are completely determinate in accordance with the laws of dynamics? Is the physical a complete system without taking account of any action on it arising from the psychical, or is it, on the other hand, necessary to suppose that an action of the psychical on the physical exists, without which the actual motions of the physical cannot be completely determined? If the latter question be answered affirmatively, then it makes no difference in principle whether such action of the psychical does work, or whether it can be represented by the introduction into the dynamical system of *ex hypothesi* unknown frictionless constraints; in either case the laws of physics, regarded as a sufficient system for the determination of all motions, fall to the ground.

Sir O. Lodge's contention "that the fundamental laws

[1] Mildness, Faithfulness, Self-Respect, Respect to Others, and Complaisance. When asked about Confucius's character, Tsze-Kung, the most eloquent of all his disciples, enumerated these as its five components. In the eighteenth century there was a Confucianist master in Japan who opined it wise to substitute in the temples the five letters signifying them written on scrolls for the images of the philosopher. See the "Analects of Confucius" and the "Kwagetsu Shinshi."

of physics, complete and accurate as they are, in no way exclude guidance of events by the agency of life or mind or other unknown influence" cannot, it appears to me, be regarded as true in any sense relevant to the main issue between naturalism and its opponents; that his contention holds because the psychic can be supposed to be sufficiently dexterous to apply all its interfering forces on matter "perpendicular to the direction of motion" is, to my thinking, a complete fallacy based upon an undue estimate of the importance of the conservation of energy as compared with a more general formulation of dynamics.

In an earlier part of his paper Sir O. Lodge has endorsed a somewhat different form of statement: "That life is something outside the scheme of mechanics, although it can nevertheless touch or direct material motion, subject always to the laws of energy *and all other mechanical laws* (the italics are mine) supplementing them, but contradicting or traversing them no whit." In this statement Sir O. Lodge has deigned to recognise the existence of the other mechanical laws. Considering that the motions of all the parts of a mechanical system are completely and uniquely determinate by means of the law of energy and all the other mechanical laws, it seems difficult to understand how room is left for supplementing these laws, or how the psychic can interfere in a mechanical system at all without traversing mechanical laws.

I have no intention of expressing any opinion whatever on the main point of dispute between naturalism and its opponents, or of discussing the question whether our experience of the world can be adequately represented by a dualism of the physical and the psychical. My sole object has been to show that in suggesting that, provided the psychical does not generate energy, it does not, by the impressing of force, really interfere with the completeness of the system of physical laws, Sir O. Lodge has simply drawn a herring across the path of the controversy between naturalism and its opponents. E. W. Hobson.

Christ's College, Cambridge, April 25.

Density and Change of Volume of Nova Persei.

Dr. Ritter, when dealing with stellar atmospheres, touched upon the question of pulsation periods and changes of density of gaseous stars. His deductions are that the brightness of a variable (gaseous) star is inversely proportional to the square of its volume, and also that the period of pulsation varies inversely as the square of the star's density. Now Nova Persei's periods of pulsation have increased from about one day to five days and longer, from which changes, according to Dr. Ritter, we can estimate that the star's density has diminished from 1/10 to 1/300 of that of water. The square of the ratio of these two fractions is 1/900. The brightness of Nova Persei should have decreased to this fraction, which is equal to a decrease of about seven magnitudes.

Important information as to the constitution of this star might be gained if a rigorous comparison between pulsation period and brightness could be carried out.

Dr. Ritter's investigations will be found in Wiedmann's *Annalen*, 1879, vol. viii. p. 177, and 1881, vol. xiii. p. 367.

C. E. Stromeyer.

A Katydid's Resourcefulness.

During the past summer an intimate friend of the writer's observed a peculiar case analogous to the Irishman's "spitting on his hands for a fresh hold." An ordinary katydid, in trying to climb along the slats of a window blind that were very smooth owing to the glazed surface of the paint, kept slipping on the smooth surface. It would raise one front leg and then the other, bringing the foot or claw to its mouth, and there wet it with the "molasses" which exuded from the creature's crop. Is this one of the practical uses made by the locust family of this sticky fluid to enable it to walk upon very smooth surfaces? If so, the writer has never had it brought to his notice before.

Iowa City, Ia., October, 1902. Arthur G. Smith.

ABORIGINAL REMAINS IN N.W. FLORIDA.[1]

THE first of these two papers deals with archæological investigations along the coastal region of N.W. Florida, being a continuation of the searches conducted during ten successive seasons along other portions of the coast and the waterways running down to it. The work on this occasion was principally centred in the districts around Perdido Bay, Pensacola Bay, Santa Rosa Sound, and Choctawhatchee Bay. As has hitherto been the case in the investigation of Floridan antiquities, a rich harvest resulted, mainly of objects of pottery. This in spite of the excavation craze which has led numbers of unskilled searchers to probe the soil for its buried treasures. "In no part of Florida," writes Mr. Moore, "is the pursuit of this *ignis fatuus* so intense, and persons, otherwise sane, seemingly, spend considerable portions of their time with spade and divining rod in fruitless search." Some twenty mounds were investigated, and the paper is devoted mainly to a detailed description of the finds. Numerous interments were discovered; the greater number of the skeletons were, however, incomplete. The custom of burying the remains of the dead under inverted earthenware bowls of large size was evidently very prevalent, and recalls the similar practice observed by the pre-dynastic Egyptians. An interesting custom is revealed in connection with the pottery vessels found with the greater number of interments. Very many of the pots buried with the dead exhibit a hole purposely broken through the base, this having been done, it is believed, in order to "kill" the vessel to free its spirit to accompany that of the departed. This custom was seemingly very largely practised, and must have been associated with a system of primitive animistic philosophy which is almost world-wide, and which finds expression under different, though kindred, forms of manifestation.

The finding of a definite class of mortuary pottery is also of great interest. These ceremonial pots were usually small, often somewhat fantastic in form, and of poor materials, and a very interesting feature consists in their basal perforations having been made *at the time of manufacture*. These vessels were, in fact, made for ceremonial "killing"—one may say, were made ready-killed—and they served as cheap substitutes for the more valuable useful forms. A parallel is thus afforded to the modern Chinese practice of burning at funerals cheap paper models of useful objects, money, &c., and to the specially-made valueless burial coins of Egypt and elsewhere.

The decoration upon the pots is for the most part bold in design, and incised or stamped, at times exhibiting zoomorphic or anthropomorphic themes in partial or complete relief. Some of the incised scroll-work is very skilfully executed, and gives a bold, intricate and effective pattern, notably in the case of a fine vase from a mound near Point Washington.

The second short paper deals with researches conducted along the Tombigbee River by the same explorers. A large number of mounds and camp sites were examined, and about 178 miles of the river banks were searched. The results were disappointing, and but poorly rewarded the labour expended. The mounds were largely domiciliary, and the finds from them were few in number. The author gives a complete list of mounds and camp sites along the region examined, and of the names of the owners of the properties upon which they stand, and this should prove very useful to future investigators.

[1] "Certain Aboriginal Remains of the North-West Florida Coast and the Tombigbee River." Two papers by Clarence B. Moore. *Journ.* of the Academy of Natural Sciences of Philadelphia, second series (vol. xi., part 4, 1901.)

POSITIVE SCIENCES AT THE INTERNATIONAL CONGRESS OF HISTORY.

THE name of Rome and the favourable season gave to the congress recently held in the Italian capital an international character, evident, not so much in the numerous concourse of visitors from all parts, as in the nature of the subjects treated. The congress was interesting, not only with regard to the original communications on historical subjects, but still more so respecting the series of discussions on the necessity of collecting and putting in order the material for study so as to render it easily accessible. Bibliographical questions are of greater importance to the historian than to the man of science. The latter, who has at his disposal material in a great measure of recent date and easily accessible, has been able, with greater facility than the historian, to get up good indexes and catalogues; but the difficulties which stand in the way of those desirous of collecting historical data, and of those who have to put them in order, varying, uncertain, obscure as such data are, scattered here and there in innumerable archives and libraries, are very great indeed.

All, or nearly all, the resolutions voted by the congress refer persistently to the necessity of the publication of catalogues, bibliographies, of entire bodies of documents of a given kind, of atlases, reproductions, &c., and, contrary to what is customary amongst Anglo-Saxon peoples who rely more on personal initiative, an appeal is, of course, made to Governments and academical bodies.

The importance assumed by the eighth section—"History of the Sciences"—is a gratifying fact to the cultivators of positive sciences. At the historical congress of Paris in 1900 this section was less attended; in Rome, on the contrary, the students of the history of the principal sciences were represented, assembled in friendly unanimity for a common object.

Amongst the mathematicians I may mention Tannery, who traced the origin of the terms "analysis" and "synthesis" in mathematics; Loria, who, besides other communications, spoke in favour of the publication of the works of Torricelli; Vailati, who spoke on the theory of the lever according to Archimedes; Torni-Bazza, who treated of Niccolò Tartaglia and of an inedited manuscript of Oxford, and others.

Pirotta gave an account of the science of botany and its bibliography in Rome, Mattirolo spoke on Aldovrandi, Celani and Baldacci presented antique herbaria.

Camerano narrated the history of the doctrines of Lamarck in Italy at the beginning of the nineteenth century.

Guareschi, with the aid of documents, showed the accusations of plagiarism against Lavoisier, formulated originally in England, to be unfounded.

Sudhoff treated of Paracelsus and his writings; Blanchard, of the *jetons* of the members of the medical faculty of Paris; Barduzzi, of the University of Siena and of Andrea Mattioli; Pensuti, of the hospitals of antiquity.

Günther discussed the *Jacobsstab* (Jacobs's-staff or cross-staff), an ancient astronomico-geodetic instrument erroneously attributed to Regiomontanus; Millosevitch showed the necessity of promoting the knowledge of Ginzel's canon of eclipses as a means of ascertaining the dates of the period of classical antiquity. There were communications on the history of the tides (Almazia), on the mariner's compass (Moretti), and on seismology (Baratto).

On a motion of Giacosa, a catalogue of the writings on scientific subjects extant in the archives and libraries of the kingdom was voted; the necessity of courses of lectures on the history of the sciences in the universities was discussed, the limits of these courses being then determined, and finally, a permanent international committee was appointed, to which was entrusted the care of the section of the history of the sciences at the future congress of Berlin.

Positive sciences were likewise dealt with in some other sections. Montelius demonstrated the extension of relations between Italy and Scandinavia, proved by the amber trade up to the Bronze age. The woollen industry, introduced principally from England, and its economic results were discussed (Schulte). An interesting communication by Bargagli-Petrucci related the measures taken in Siena in the thirteenth and fourteenth centuries to provide the town with drinking-water, and the deliberations on the subject.

Modern science with its positivistic ideas has likewise not been without influence on the history of methodics. Thus, Vailati treated of the applicability of the notions of cause and effect in the domain of historical sciences, whereas Hartmann argued that history must follow evolutionist methods, excluding consciousness as a causal factor. PIERO GIACOSA.

JULIUS VICTOR CARUS (1823–1903).

TWO generations of zoologists have been familiar with the name of J. V. Carus, who died in Leipzig on March 10 at the age of fourscore years. His name has come to be associated with zoological scholarship, with bibliographical and historical work, with the promulgation of Darwinism, and with the *Zoologischer Anzeiger*, which he edited for the last quarter of a century.

Julius Victor Carus was born at Leipzig on August 25, 1823; he came of a scientific family, represented by several famous names in the history of science. His father was an illustrious surgeon—for a time professor at Dorpat; his mother was the daughter of a renowned gynæcologist. From 1841 onwards, Carus studied medicine and natural science at the famous university of his birthplace, and in 1846 he became assistant physician at the Georgen-Hospital there.

But zoology had a stronger hold on him than medicine, and thus we find him pursuing comparative anatomy at Würzburg, at Freiburg i. Br., and at Oxford (autumn of 1849). At Oxford he acted as conservator of the Museum of Comparative Anatomy, and it was there that he perfected his wonderful command of the English language. In 1851 he returned to Leipzig as a docent, and there he remained, as professor extraordinarius of comparative anatomy, and as director of the zootomical collections, for more than half a century. There was, indeed, a notable break in 1873 and 1874, when he acted as *locum tenens* in the chair of zoology in Edinburgh for Prof. Wyville Thomson, then absent on the *Challenger* expedition. In Edinburgh memories still linger of his excellent lectures on comparative anatomy, which seem to have been somewhat in advance of the requirements and desires of the majority of his large constituency of medical students.

Carus was a man of extraordinary industry, with a high ideal of careful and scholarly workmanship, and instinctively interested in the history of his science. Thus he did more in the way of translation and bibliography, exposition and history than in the way of original research. It will be an evil day for natural science when this type of worker fails to be appreciated.

Among the works of Prof. J. Victor Carus we may note an early paper on alternation of generations

("Zur nähern Kenntniss des Generationswechsels"), Leipzig, 1849; his "System der tierischen Morphologie" (1853); his beautiful atlas, "Icones Zootomicæ" (1857); his text-book, "Handbuch der Zoologie," in collaboration with Gerstaecker (1863–1875); his essay "Ueber die Wertbestimmung der zoologischen Merkmale" (1854); his investigation on Leptocephalids (1861); his useful "Prodromus Faunæ Mediterraneæ" (2 vols., 1884–1893); his "Bibliotheca Zoologica," in collaboration with Engelmann (2 vols., Leipzig, 1862); his edition of the *Zoologischer Anzeiger*, since its beginning in 1878; his excellent translations of the more important of Darwin's works, of Lewes's "Physiology of Daily Life," &c.; but above all his erudite and invaluable history of zoology ("Geschichte der Zoologie"), 1872. Although this well-known history is not marked by the genius which illumines Sachs's "History of Botany," it is a great work, quite enough in itself to make the name of Carus famous.

In reference to Carus's translation of Darwin's works, it is interesting to recall what Mr. Francis Darwin says in the "Life and Letters," vol. iii. p. 48. "From this time (1866) forward Prof. Carus continued to translate my father's books into German. The conscientious care with which this work was done was of material service, and I well remember the admiration (mingled with a tinge of vexation at his own shortcomings) with which my father used to receive lists of oversights, &c., which Prof. Carus discovered in the course of translation. The connection was not a mere business one, but was cemented by warm feelings of regard on both sides." In 1866 we find Darwin writing to Carus:—"I wish I had known when writing my historical sketch that you had, in 1853, published your views on the genealogical connection of past and present forms."

While Carus did not himself make many contributions to the research-literature of zoology, he was certainly one of those who facilitated the progress of the science. It is hard to say how much we owe to the persistent patience implied in the onerous labour of editing the *Zoologischer Anzeiger*, which has helped to keep us up to date for so many years, and has prompted other *Berichte* on similar or different lines. There can be no doubt that Carus gave his mature strength to making this journal a success—an indispensable item in every zoological laboratory, and an organon of progress. We are glad to see that the editorship, which he so ably discharged, has passed into the expert hands of Prof. E. Korschelt.

Although he lived a very quiet and unobtrusive life—*arbeitsreich*, as his fellow-countrymen say—he had his share of honours. He was an honorary doctor of philosophy of the University of Jena, and an LL.D. of both Oxford and Edinburgh, and he received decorations from Prussia, Saxony, and Russia. Herr Professor, Dr. med., phil. et jur. Julius Victor Carus, Ritter pp., was the doyen of the medical faculty of the University of Leipzig, and his obsequies were duly honoured both by the University and by the city on March 13. In the venerable Paulinerkirche the University preacher, Prof. D. Rietschel, spoke of Carus's devotion to science, literally maintained "till the pen dropped from the wearied fingers," of his keen artistic interests, of the nobility of his character, and of the strength of his family affections. He leaves a widow, three daughters (one married to Dr. J. Lehmann), and a son, Victor, to lament his loss. The Dean of the Medical Faculty, Prof. Hoffmann, spoke of his scientific patience and of the loyalty of his services along lines which frequently weakened health and other personal inhibitions left open to him. The fact seems to be that Carus might have been *professor ordinarius* at Leipzig if he had not gracefully and magnanimously bowed to the strong claims of Rudolf Leuckart; "er war kein Streber und verstand es nicht seine Forschungen schnell genug zur Discussion zu stellen, sondern er legte sie in grossen Arbeiten langsam nieder." Thus it is readily intelligible why he devoted himself to a line of work which was not only organically congenial, but brought him some security of income.

It is, therefore, all the more desirable that we should record, as it were from a distance, how much we honour the name of Carus—as a bibliographer, as a historian of the science of zoology, and as one who, by persistent patience of recording, has made the steps of progress easier to thousands. J. A. T.

NOTES.

A Royal Commission has been appointed to obtain and distribute full information as to the best mode by which the United Kingdom and British dominions may be represented at the St. Louis International Exhibition to be opened next year, to assist with advice and cooperation, and generally to promote the success of the exhibition. The commissinners are:—His Royal Highness the Prince of Wales, president; Viscount Peel, chairman; the Earl of Jersey, Earl Howe, Lord Castletown, Lord Inverclyde, Lord Alverstone, Lord Avebury, Mr. Horace Plunkett, the Hon. Charles Napier Lawrence, the Hon. Sir Charles W. Fremantle, Sir G. Hayter Chubb, Sir Edward J. Poynter, Sir C. Rivers Wilson, Sir E. Maunde Thompson, Sir William H. Preece, Sir W. T. Thiselton-Dyer, Sir Herbert Jekyll, Sir Lawrence Alma-Tadema, R.A., Sir C. Purdon Clarke, Sir George T. Livesey, Mr. Henry H. S. Cunynghame, Mr. Edwin A. Abbey, R.A., Mr. Charles Vernon Boys, F.R.S., Mr. Thomas Brock, R.A., Mr. George Donaldson, Prof. C. Le Neve Foster, F.R.S., Mr. John C. Hawkshaw, Mr. Thomas G. Jackson, R.A., Mr. W. Henry Maw, Mr. F. G. Ogilvie, Mr. William Q. Orchardson, R.A., Mr. Beverton Redwood, F.R.S., Mr. Alfred G. Salamon, Mr. Joseph W. Swan, F.R.S., Mr. J. J. Harris Teall, F.R.S., and Mr. F. W. Webb. Colonel C. M. Watson, C.B., is appointed secretary of the Commission.

At a meeting of the above commissioners on Tuesday, the Prince of Wales gave a short practical address, in the course of which he remarked: "Both France and Germany appear fully to realise the advantages to be gained by making a good display of their productions, and in these countries large sums have been provided by their respective Governments to assist in meeting the expense of the exhibits. There is one point to which it would seem desirable to direct attention. In previous international exhibitions, while other countries have arranged to have combined national displays in certain groups, it has been the habit for British manufacturers to show individual exhibits, rather than to combine together so as to produce the best possible effect. It is hoped that in the case of the St. Louis Exhibition it may be possible to arrange so that exhibitors will combine in order to display British products to the best advantage. It should be remembered that the competition will not be between individual British manufacturers, but between them as a whole and their foreign rivals. As regards the amount which will be available to carry out the work of the Royal Commission, I understand that His Majesty's Government has included a sum of 30,000*l.* in the Estimates for 1903–04 as a commencement, and that a decision will not be arrived at as to the total amount to be granted until it has been ascertained to what extent British manufacturers show a willingness to take part in the exhibition."

We learn from the *Times* that the first annual meeting of the South African Association for the Advancement of Science, which already has 762 ordinary and 30 associate members, was opened on Monday at Cape Town, the Governor, Sir Walter Hely-Hutchinson, being among those present. Sir David Gill, K.C.B., F.R.S., delivered the presidential address. He urged the special claims of science upon the colonies and colonial Governments, and referred to the duties of the Association and to the prospects of scientific progress in South Africa. He also referred to the proposed visit to South Africa of the British Association in 1905, and the great good which would result from such a visit of scientific men.

We regret to see the announcement of the death of Prof. J. Willard Gibbs, of Yale University, where he had filled the chair of mathematical physics since 1871. Prof. Gibbs was in his sixty-fifth year, and was elected a Foreign Member of the Royal Society in 1897.

The death is announced of Mr. A. F. Osler, F.R.S., distinguished by his meteorological studies and the self-registering anemometer which bears his name. Mr. Osler was ninety-five years of age, and was elected a fellow of the Royal Society in 1855.

The governing body of the Jenner Institute of Preventive Medicine will shortly appoint a director of the Institute, and applications are invited for the post.

The subject of the Silliman lectures to be given at Yale University by Prof. J. J. Thomson, F.R.S., will be "The Present Development of Our Ideas of Electricity." The lectures, eight in number, begin on May 14.

An International Kite Competition has been arranged for June 25 to be held on the Sussex Downs. Amongst the jury are Mr. C. V. Boys, F.R.S., Dr. W. N. Shaw, F.R.S., Sir Hiram Maxim, and Dr. H. R. Mill.

It is reported by the *Times* correspondent at Sofia that preparations are being made at Odessa for the establishment of telegraphic communication with Varna by the Marconi system. The Russian authorities will thus be able to avoid the use of the telegraphic lines traversing Rumania.

There will be extra meetings of the Institution of Electrical Engineers on April 30 and May 7. It is expected that Mr. Aitken's paper on "Divided Multiple Switchboards: an Efficient Telephone System for the World's Capitals," will be read and discussed at the former meeting.

A Reuter telegram from Cape Town states that Dr. Rubin is about to leave there for Chinde, with a party of observers and native carriers, for the purpose of measuring an arc of meridian into North-eastern Rhodesia, from the Zambesi to Lake Tanganyika. The expedition will be away three years.

On Monday next, May 4, the Berlin Gesellschaft für Erdkunde will celebrate the seventy-fifth year of its existence by a special meeting and a banquet. At the meeting a report will be read on the scientific activity of the Society during the past five years, Dr. Sven Hedin will give an address on his explorations in Tibet, and Prof. K. Sapper one on his studies of volcanic eruptions in the West Indies and Central America.

It is stated in *Science* that the Swedish Government has voted 4000*l.* for the publication of the scientific results of Dr. Sven Hedin's journey through Central Asia. The work will comprise an atlas of two large volumes, while a third volume will contain Dr. Hedin's report on the geography of the country. Further volumes will be devoted to the meteorological, the astronomical, and the geological observations, and to the botanical and zoological collections. The work will be published in English.

In reply to a question asked in the House of Commons on Tuesday, Mr. Gerald Balfour said that up to the present time, in spite of careful negotiation, the Board of Trade has been unable to effect arrangements for a system of wireless telegraphy from shore to ship and ship to shore. The same difficulties have not arisen in the case of communication between ships at sea. Mr. Arnold-Forster informed the House on the same day that the present average expenditure upon wireless telegraphy in the Navy is about 20,000*l.* per annum.

The council of the Institution of Civil Engineers has made the following awards for papers read and discussed before the Institution during the past session:—A Telford gold medal to Mr. Maurice Fitzmaurice, C.M.G., a Watt gold medal to Mr. B. Hopkinson, and a George Stephenson gold medal to Mr. P. J. Cowan. Telford premiums to Messrs. C. Hopkinson, E. Talbot, F. W. S. Stokes, P. J. Cowan, J. T. Milton, and W. J. Larke. The presentation of these awards, together with those for papers which have not been subject to discussion and will be announced later, will take place at the inaugural meeting of next session.

A recent cablegram from Captain Colbeck brings the information, says the *Times*, that, when he discovered the position of the winter quarters of the National Antarctic expedition, the ice prevented him from bringing the *Morning* nearer than eight miles to the *Discovery*. The transshipment of coals and provisions had, therefore, to be done by means of sledges dragged over that distance. The *Discovery* is only provisioned until next January, so that the despatch of the *Morning* for her relief a second time is an absolute necessity in order to avoid a catastrophe. For the additional expense a sum of 12,000*l.* is urgently needed, 6000*l.* this year and the rest next year.

The *Tageblatt* publishes a wireless telegram transmitted by its correspondent from a train running between Rangsdorf and Zossen. The message states that experiments with wireless telegraphy were made from a train in motion on the Berlin-Zossen section of the military railway by a wireless telegraph company using the Braun-Siemens system. During the journey active communication was maintained between Marienfeld and Rangsdorf stations and the train, and trustworthiness in transmission was found in every case.

Mr. C. C. Paterson has been appointed to take charge of the electrotechnical work, including photometry, at the National Physical Laboratory. Under an arrangement with the Indian Government the laboratory is about to take over the work of preparing the tide tables for Indian ports. In this it will have, for the present, the assistance of Mr. Roberts, of the "Nautical Almanac" Office, in whose hands the work has been for many years. The committee has appointed Mr. F. J. Selby, formerly scholar of Trinity College, Cambridge, as assistant in charge of the work.

The fourteenth International Congress of Medicine is being held at Madrid. In reality a series of congresses has been arranged. The first, that of the medical Press, commenced on April 20 in the Madrid University, and concluded on April 22. On April 23 the International Congress of Medicine proper was opened, the first meeting being held in the Theatre Royal, the King, the Queen Mother, and the Ministers being present. This main conference concludes to-day. On May 1 a third congress of Spanish-speaking European and American medical men commences and lasts for two days. On May 3 the fourth and last medical congress meets, and is to be purely a Spanish congress.

We regret to record the death of Mr. G. P. Bulman, Newcastle-upon-Tyne, at the early age of twenty-six. He contributed several papers on the marine Mollusca of Northumberland to the reports issued from the Marine Laboratory, Cullercoats. He also made some experimental attempts to solve certain of the problems relating to heredity. The results he obtained with regard to "hybrid oochromy" were described in Nature, June 27, 1901 (p. 207). At the time of his death he was carrying on in the gardens of the Durham College of Science an experiment to test the much-discredited phenomenon, telegony—about which he wrote in *Natural Science*, vol. xiv.

Mr. F. J. M. Page, writing from the Chemical Laboratory, London Hospital, states that radium bromide seems to have more penetrating power than the nitrate. Using the bromide he observed a distinct luminosity on a zinc sulphide screen after the rays had passed through ten post-cards and the card of the screen (in all 5 millimetres). A diamond was found to be superior to zinc sulphide in detecting these rays; thus, on covering the bromide with a florin, no effect on the zinc sulphide could be seen, whereas a diamond glowed perceptibly when placed on a heap of *five* florins (8.5 mm.) over the radium salt. A barium platinocyanide screen proved to afford a slightly more delicate test than the diamond.

At the meeting of the Institution of Mechanical Engineers on Friday, April 24, the president, Mr. J. H. Wicksteed, gave an address in which he traced briefly the development of the uses of iron, and Prof. W. E. Dalby read a paper on the education of engineers in America, Germany and Switzerland. Mr. Wicksteed remarked that in the earliest written records to which an accurate date can be fixed, namely, in the fourth millennium B.C., pyramid texts are found which prove beyond question that iron was well known in Egypt at that time, and that it was forged into weapons, tools and instruments. After an obscure existence of at least 3000 years, iron became historically famous. The time of Homer, 880 B.C., was notable for the attention that was given to iron. The iron of antiquity was made direct from the ore, and was spongy malleable iron, which could be made more or less steely; and it was only as reducing furnaces were enlarged and the blast increased that it came about within the last 400 years that cast-iron was produced on a commercial scale. Up to that time, bronze held the field for objects which could not be shaped by hand-hammering. The best authorities give the date 1490–1500 for the discovery of cast-iron, and it is remarkable that this discovery exactly corresponds with the revival of letters in England. From this time iron became as tractable as bronze, and the iron foundry was added to the forge.

A large audience attended the meeting of the Royal Geographical Society on Monday to hear papers by Captain Sverdrup and Mr. P. Schei on four years' Arctic exploration and scientific observation in the *Fram*. From the furthest point north to which the expedition advanced—namely, Land's-lok, in about 81° 40′ north lat., and long. 94° W.—they were unable to see land either towards the north or towards the west, and some new islands which were discovered would appear to form the natural termination of the Polar archipelago north of the American continent. Although Captain Sverdrup was not prepared to assert that no land really existed north or west of the point he had indicated, he thought it extremely unlikely that land would be discovered in those directions, for as far as ever they were able to see there was nothing but sea covered with ice of the usual coarse Arctic character. Captain Sverdrup said that in many parts of the newly-discovered lands there appeared to be an abundance of animal life, especially musk-oxen and smaller game, such as hares and ptarmigan, as well as foxes and wolves. Bears also were numerous in parts. Almost everywhere remains were discovered of Eskimo habitations. The scientific results of the expedition are very valuable. Meteorological observations were taken every second hour, both in summer and in winter; records were also made of the temperature of the sea and of the ice, as well as of the tidal water. Magnetic observations were made at each of the several winter quarters. The expedition brought home rich and valuable materials for the study of the zoology, botany, and geology of parts of the Arctic which had never before been visited. The *Fram* reached Norway on September 12, 1902, after an absence of four and a quarter years.

Symons's Meteorological Magazine for April contains articles of exceptional interest relating to the rainfall of the last winter, the shortage of water, and the storm of February 26, by Prof. C. J. Joly, Astronomer Royal for Ireland. We select for especial notice the table of rainfall extremes at Camden Square for forty years, 1858–97. The average rainfall is 25.46 inches. The driest period is the spring, the rainfall each month from February to May being below two inches; in all other months the average fall exceeds two inches, the maximum, 2·71 inches, occurring in October. The greatest monthly fall was 6·72 inches in August, 1878, and the lowest 0·01 inch in February, 1891. The greatest daily fall was 3·28 inches on June 23, 1878. Rain falls, on an average, on 161·8 days in the year, the extremes being from 106 to 204 days.

The appendix to the reports of the British South Africa Company on the administration of Rhodesia, for 1900 to 1902, contains a meteorological report by Mr. George Duthie. During the year ended March 31, 1902, or part of it, there were in operation seven barometric stations (three in Mashonaland and four in Matabeleland), three climatological or thermometric stations (one in Mashonaland and two in Matabeleland), and nine purely rainfall stations—making nineteen rainfall stations in all (twelve in Mashonaland and seven in Matabeleland). One barometric station and five rainfall stations have been added during the year. Mr. Duthie's report contains abstracts of the observations made at the stations, and also summaries of observations made in British Central Africa under the direction of Mr. McClounie.

The fourth, and concluding, number of vol. iii. of the *West Indian Bulletin* contains two articles by Mr. Maxwell-Lefroy, late entomologist to the Agricultural Department. The first forms the concluding portion, divided into thirteen subjects, of a lengthy account of the scale insects of the West Indies. His second paper is on "Crude Oil and Soap, a New General Insecticide." Kerosene is rather expensive in the West Indies, and so also is American crude petroleum, so Mr. Maxwell-Lefroy was induced to experiment with a crude oil mined in Barbados, and from this and soap he has obtained an emulsion which is a most valuable insecticide, from the very much increased insecticidal properties of the heavy oil used. Mr. Francis Watts has some notes on West Indian fodders, and there is a report of an address by Dr. Morris on agricultural efforts at Dominica.

We have to acknowledge the receipt of a brochure on the causes of weather and earthquakes, from Captain A. J. Cooper, who is known to hold some rather unorthodox views on the subject of tides and other phenomena. The greater part of the pamphlet is occupied with comparisons between the dates of storms and the configuration of the

planets. The principle on which this comparison is made seems to be wrong. A storm having been recorded, an inquiry is made into the positions of the planets, moon, &c. It would be more convincing if, from the arrangement of the planets, the weather was foretold. The reply of the author is, however, that we do not know sufficient of the state of the weather over the whole world to be able to say whether the prediction is justified or not. The author does not seem to have read Prof. Schuster's address to the Astronomical Section at Belfast, in which he will find discussed the true principles which indicate a real connection between phenomena in which some relationship can be traced.

A METHOD of studying the action of insects' wings by instantaneous photography is described by Herr Robert von Lendenfeld in the *Biologisches Centralblatt*. The photographs were taken by concentrated sunlight, as many as 2500 exposures per second being obtained by revolving a cog-wheel in the plane in which the image of the sun was focused. The photographic images of the insect were separated by means of a revolving mirror. One great difficulty was to make the fly fly, and it must not be forgotten that the insect was confined in a very restricted space, or even in some cases held in the fingers, thus hardly reproducing the conditions of free flight.

IN a note in the *Bulletin* of the Imperial Naturalists' Society of Moscow, M. W. Mamontow describes a diamond contributed to the mineralogical museum at Moscow from the Ural Mountains. It was one of four diamonds found in a new secondary bed near the village of Koltachi; it weighed 1·107 carat, and its specific gravity was 3·516. Most of the Ural Mountain diamonds weigh less than a carat. The author describes sixteen deposits in the southern and central Urals from which more than 222 crystals have been obtained in seventy-three years.

WHETHER the microbes which are constantly present in the intestinal canal of man and animals are essentially necessary to promote digestion, are harmless and unnecessary, or are even injurious, is a question on which various observers have arrived at different results. In a paper communicated to the *Bulletin* of the Imperial Naturalists' Society of Moscow, Mdlle. P. V. Tsiklinsky discusses this question. From an examination of the literature of the subject, and from a study of the microbe flora in question, the authoress is led to believe that, while certain microbes do undoubtedly promote digestion, and, in accordance with M. Metchnikoff's observations, in some cases exercise an antagonistic influence against germs of disease, it is probably possible, by artificial means, such as by variation of diet, to dispense with the bacteria in question, and thus to avoid the danger that they often cause in the living animal. Further, the view is put forward that the thermophilous microbes of the intestinal canal are mere varieties of ordinary non-thermophilous microbes, and not distinct species.

WE have received from Messrs. W. Watson and Son, of High Holborn, their latest catalogue of microscopes and accessories. Among the new items may be mentioned the series of substage condensers, which, through the courtesy of Messrs. Watson, we have had an opportunity of testing. These are all of a high order, especially the "holoscopic" oil immersion condenser, which appears to be as good as, if not superior to, any similar condenser we have had through our hands. The "macro illuminator" is a most useful accessory for low-power photomicrography, the illumination of large objects being by its aid very easily accomplished. There is also described a new two-speed fine adjustment, the design and construction of which is of considerable merit as well as a fine adjustment, designed for photomicrography and high-power work by Mr. E. B. Stringer, which should be of the greatest value to workers in these branches. The well-known "Van Heurck" microscope, than which there is probably no finer instrument to be obtained, is again described fully, as well as a new metallurgical microscope, for which there should, in view of the great advances recently in this branch of work, be a considerable demand.

WE have received what appears to be the first part of a new Italian entomological journal, *Redia*, published at Portici. This part comprises a single memoir, by Signor F. Silvestri, on the termites and the insects which live with them of South America. For the purpose of his researches the author visited Argentina in 1898, and Chili and Uruguay in the following year, obtaining a vast store of material, which has since been carefully worked out. The present memoir contains accounts of a number of new generic and specific types discovered by the author. Six plates are devoted to details of structure.

A UNIQUE specimen has been added to the gallery of fossil reptiles in the Natural History Museum. This is a considerable portion of the skeleton of a gigantic sauropod dinosaur obtained from the Oxford Clay near Peterborough by Mr. E. N. Leeds, of Eyebury. When first the bones of this species were discovered some years ago, they were described by the late Mr. J. W. Hulke as *Ornithopsis leedsi*, but the generic title has since been changed to Cetiosaurus. The remains include the tail, sacrum, and parts of one hind and one fore limb. The Peterborough dinosaur, which is evidently allied to the American Diplodocus (of which restored sketches are placed alongside), is the first example of the larger forms of these reptiles found in Britain of which enough of the skeleton has been found to admit of its being mounted. The mounting reflects the greatest credit on the mason and artificers of the museum.

AMONG the series of memoirs on the fishes of Japan by Messrs. Jordan and Fowler, to which allusion has so frequently been made in these columns, none is of more general interest than the one on the sharks and rays (Elasmobranchs), forming No. 1324 of the *Proceedings* of the U.S. Nat. Mus. Of the numerous forms recorded, by far the most noteworthy is the shark described as *Mitsukurina owstoni*. The genus and species are based on a single specimen captured in 1898 off Misaki in deep water, which, until November of last year, remained the only known example. Dr. Smith Woodward has suggested that this shark is not generically distinct from the Eocene Scapanorhynchus, but this is not admitted by the authors of the memoir before us, although the characters on which they maintain its distinctness appear insignificant. Messrs. Jordan and Fowler adopt more family groups than is usual, and use several names which are unfamiliar, although in employing Cetorhinus, in place of Selache, for the basking-shark they are undoubtedly right.

As Prof. L. Bailey has made a special study of plant-breeding and plant form, he is well qualified to discuss the modern theories of variation and principles of hybridisation. These subjects he treated in an address delivered before the American Society for Plant Morphology and Physiology, and his paper has been printed in *Science*. Prof. Bailey points out that the most important part of Mendel's contribution is the law of heredity which he put forward, which is based upon similarity or purity of the two fusing elements.

THE Botanical Club of Canada has endeavoured to stimulate the collection of phenological records throughout the various provinces of the Dominion, and in Columbia and

Nova Scotia many of the schools undertake these observations as a form of nature-study. The schedules which have been distributed include the observation of farming operations and a few meteorological phenomena, in addition to the ordinary data connected with the opening of flowers. The annual report contains a series of observations made in Nova Scotia, from which average dates or phenochrons are calculated.

Attention is directed by Mr. O. E. Dunlap to a remarkable diversion in the waters of Niagara which happened on March 22 (*Scientific American*, April 4). On the previous afternoon ice came down the upper river from Lake Erie in such quantities that immense masses lodged on the rocks above Goat Island and diverted the water from the American to the Canadian channel. Thus the river-bed above the American fall between the mainland and Goat Island was left practically dry, and numbers of people were able to walk from Green Island over reefs of rock to the head of Goat Island. Here and there gravelly deposits and loose blocks of limestone were to be seen, amid great patches of ice, and barely enough water fell over the limestone ledge to curtain the rocky cliffs below. It is recorded that a similar incident occurred on March 29, 1848.

The fossil fruits to which Bowerbank gave the name Nipadites have in this country been obtained from the London Clay of Sheppey and the Bracklesham Beds of Sussex. The various forms from the Eocene strata of Belgium have been grouped under one specific name, *Nipadites Burtini*, given by Brongniart in 1828 (as *Cocos Burtini*), and of which the *N. giganteus* of Bowerbank and the *N. Bowerbankii* of Ettingshausen are regarded as synonyms. These conclusions are stated in an essay by Mr. A. C. Seward and Mr. E. A. N. Arber (*Mém. Musée Roy. d'Hist. Nat. de Belgique*, tome ii., 1903). The authors remark on the structural resemblance between the fossil fruits and those of the recent palm, Nipa, which flourishes in the East Indies from the Lower Ganges and Ceylon, across the Malay Peninsula and Archipelago, even to Australia.

On Tuesday evenings during May the following lectures will be given at the Royal Victoria Hall:—Dr. Mill, on "Weather and Weather Prophets"; Dr. Bertram Abrahams, on "Egypt"; Mr. Cunningham, on "Fishes"; and Canon J. W. Horsley, on "Insects."

Prof. N. W. Lord's "Notes on Metallurgical Analysis" have reached a second edition. In its new form the book is not only suitable for students in technical schools, but also as a book of reference for use in metallurgical laboratories. Methods for the determination of all elements likely to be encountered in ordinary analyses have been included in the new edition, and the subjects of gas analysis and the testing of fuel have been more fully described than in the original issue of the volume. The book is issued from the Metallurgical Laboratory of the Ohio State University.

The twenty-eighth issue—that for 1903—of the *Aide-Mémoire de Photographie*, edited by M. C. Fabre and published under the auspices of the Toulouse Photographic Society by M. Gauthier-Villars, of Paris, is full of valuable information for photographers. In addition to the lists of the principal photographic societies in Europe and America, the photographic magazines, and books on photography published during 1902, it contains a detailed review, in seven chapters, of photographic developments during last year.

The additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Papio porcarius*), four Black-backed Jackals (*Canis mesomelas*), two Caracals (*Felis caracal*), a Feline Genet (*Genetta felina*), a Dusty Ichneumon (*Herpestes pulverulentus*), four Suricates (*Suricata tetradactyla*), three Levaillant's Cynictis (*Cynictis penicillata*), two Bristly Ground Squirrels (*Xerus capensis*), a Crested Porcupine (*Hystrix cristata*), five Cape Hyraces (*Hyrax capensis*), seven Spotted Eagle Owls (*Bubo maculosa*), a Bearded Falcon (*Falco biarmicus*), five Jackal Buzzards (*Buteo jacal*), a Chanting Hawk (*Melierax musicus*), five South African Kestrels (*Tinnunculus rupicolus*), a Large African Kestrel (*Tinnunculus rupicoloides*), four Leopard Tortoises (*Testudo pardalis*), a Tuberculated Tortoise (*Homopus femoralis*) from South Africa, three Rufous Weaver-birds (*Hyphantornis textor*), a Grenadier Weaver-bird (*Euplectes oryx*), three Triangular-spotted Pigeons (*Columba guinea*), seven Egyptian Geese (*Chenalopex aegyptiacus*) from West Africa, presented by Colonel A. T. Sloggett, C.M.G.; a Sykes's Monkey (*Cercopithecus albigularis*) from West Africa, a Smooth-headed Capuchin (*Cebus monachus*) from South-east Brazil, a Ring-tailed Coati (*Nasua rufa*) from South America, seven Long-nosed Vipers (*Vipera ammodytes*), two Painted Frogs (*Discoglossus pictus*), two Edible Frogs (*Rana esculenta*), a Southern Mud Frog (*Pelobates cultripes*), European; two Pennant's Parrakeets (*Platycercus pennanti*), twelve Golden Tree Frogs (*Hyla aurea*) from Australia, two Seven-banded Snakes (*Tropidonotus septemvittatus*), a Hog-nosed Snake (*Heterodon platyrhinos*) from North America, deposited.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in May:—

May 1–6. Epoch of Aquarid meteoric shower (Radiant 337° − 2°).
10. 2h. Mercury at greatest elongation (21° 31′ E.).
,, Ceres ¾° S. of μ Leonis (mag. 4·1).
11. Juno ½° N. of ϵ Ophiuchi (mag. 3·3).
12. 8h. 7m. to 9h. 5m. Moon occults χ Ophiuchi (mag. 5·0.
15. Venus. Illuminated portion of disc = 0·738, of Mars = 0·926.
,, 13h. 5m. to 16h. 27m. Transit of Jupiter's Satellite III. (Ganymede).
19. Neptune in conjunction with η Geminorum, Neptune 10′ S.
20. 14h. Venus in conjunction with ϵ Geminorum, Venus 10′ N.
21. Juno (mag. 8.7) in opposition to the Sun.

Nova Geminorum before its Discovery.—On receiving the Kiel announcement of Prof. Turner's discovery of Nova Geminorum, Prof. Pickering instituted a search for this object on the early photographs of this region taken for the Henry Draper memorial series.

A negative obtained on March 1d. 15h. 3m. (G.M.T.), whilst showing stars of 11·9 magnitude, shows no trace of the Nova, neither could the latter be found on any of the sixty-seven plates of this region taken between March 3, 1890, and February 28, 1903, although most of them show stars of the twelfth magnitude or fainter. A plate obtained on March 2d. 13h. 19m. shows stars of magnitude 9·0, but shows no object in the Nova's position.

On a photograph taken March 6d. 14h. 28m. there is the image of an object occupying the position of the Nova, the photographic magnitude of which is 5·08 ± 0.26, and negatives taken on several succeeding nights show that the magnitude gradually decreased until on March 25 it was only 8·08.

The photograph obtained on the last-named date was taken with an objective prism, and shows the spectrum of the Nova as a conspicuous object amongst the spectra of the surrounding stars. This spectrum shows six bright

lines, their designations, assumed wave-lengths, and relative intensities being as follows :—

Hζ, 3889, (1) ; Hϵ, 3970, (3) ; Hδ, 4102, (8) ; Hγ, 4341, (10) ; —, 4643, (11) ; and Hβ, 4862, (9).

No dark lines are shown on the photograph, but this may possibly be due to the small dispersion employed. The same lines, together with the nebula line at λ 5003, are shown on spectrograms obtained on March 29 and 31, and April 1, the nebula line appearing as brighter than Hζ and of intensity 2–3. Later photographs contain lines at the estimated positions λ 4176, λ 4240 and λ 4462.

Prof. Pickering remarks on the utility of such a series of systematic observations as are carried on under the Draper memorial fund, and states that even in the absence of Prof. Turner's discovery and prompt announcement, Nova Geminorum would have been discovered, for its spectrum was a very conspicuous object on the Harvard photograph of March 25 (H.C.O. *Circular*, No. 70).

Recently Discovered Terrestrial Gases in the Chromosphere.—Owing to their proved relationship to helium, Prof. S. A. Mitchell, of Columbia University, suspected that the recently discovered gases neon, argon, krypton, and xenon might be found to exist in the chromosphere, and in order to test his supposition he compared the wave-lengths of the lines in their respective spectra with the wave-lengths of the chromospheric spectrum obtained by himself during the Sumatra eclipse.

Owing to the low densities of the new gases, it is to be expected that, as is the case with helium, they will not appear in the normal solar spectrum, even though they may appear in the spectrum of the chromosphere; and again, owing to the low atomic weights of neon and argon, Prof. Mitchell expected that these two gases might appear in the spectrum, whilst krypton and xenon, the atomic weights of which are greater, would probably not so appear.

As a result of his comparison Prof. Mitchell comes to the conclusion that lines due to neon and argon are present in the chromospheric spectrum, but the evidence as to the presence of krypton and xenon is, at present, inconclusive. Lines which are due to the more volatile gases of the earth's atmosphere (*i.e* those which are uncondensed at the temperature of liquid hydrogen), as published by Liveing and Dewar, appear at $\lambda\lambda$ 4047, 4398, 4422, 4431, 4540 and 4844, and the strongest argon lines, viz. those at $\lambda\lambda$ 4180.3, 4200.8, 4259.5, 4266.8 and 4430.3, are also represented in the spectrum of the chromosphere.

Prof. Mitchell suggests that these gases may have come to the earth's atmosphere from the sun, as suggested in the theory put forward by Arrhenius, which supposes that ionised particles are constantly being repulsed by the pressure of light, and thus journey from one sun to another (*Astrophysical Journal*, No. 3, vol. xvii.).

Catalogue of Measures of New Double Stars.—In *Bulletin* No. 29 of the Lick Observatory, Prof. R. G. Aitken publishes a further addition of 117 new double stars and their measures to his new catalogue of these objects; the earlier sections of this catalogue have already appeared in previous numbers of the Lick *Bulletins* and in the *Astronomische Nachrichten*.

The present section deals with Nos. 313 to 429 (Aitken) inclusive, and gives the position for 1900, the number in previous catalogues, the magnitude and the dates and figures of the various measures for each star. More than one-half of the pairs in this section are separated by angular distances not exceeding 1″, and more than three-fourths are only separated by 2″ or less.

The doubles have been discovered with the 12-inch telescope, but nearly all the measures have been made with the 36-inch.

"The Cambrian Natural Observer."—The latest issue of this interesting little volume, which is the official organ of the Astronomical Society of Wales, contains many interesting records of observations, both astronomical and meteorological, made by members of the Society during 1902. In future the "Observer" will only appear annually instead of quarterly as hitherto.

SEISMOLOGICAL NOTES.

The last publication of the Earthquake Investigation Committee of Japan contains five papers illustrated by twenty-six plates, all of which are the work of Dr. F. Omori. The first of these refers to a horizontal pendulum tromometer, which is essentially a conical pendulum seismograph carrying a load of 50 kg. and writing indices with a multiplication of 120. In addition to recording earthquakes, it indicates the almost continual existence of "micro tremors," the periods of which are about 0.3 second and the range 0.013 mm. When "pulsatory oscillations," which are a larger form of disturbance than the tremors, are in evidence, it would appear from the illustrations which are given of these movements that they might seriously interfere with the character of an earthquake record.

In a communication on the overturning and sliding of columns, the relationship between the horizontal component of earthquake motion and the displacement of bodies which are not attached to the ground, but simply rest upon the same, is discussed and illustrated with considerable detail. The effects of vertical motion are referred to, and cases are pointed out where gate-posts and buildings have been caused to jump. A paper bearing upon the seismic stability of tall chimneys gives the results of experiments upon the vibration of such structures. The remaining papers respectively refer to the vibration of the piers of railway bridges as caused by traffic, and the vibration of walls at the time of earthquakes.

These excellent publications are undoubtedly of great value, especially to those who have to construct to resist earthquake movements; but if the author could have given more complete references to investigations made by himself and also by others in connection with similar inquiries, their value would have been enhanced.

Other seismological notes are found in the reports of the Physico-Mathematical Society of Tokyo. In one of these, No. 16, Dr. Omori gives a summary of analyses he has made of seismograms of distant earthquakes. This is followed by notes relating to the transit velocity of the first preliminary tremor of earthquakes of near origin. We are told that the duration of these early movements has a constant relationship to the distance they have travelled. Therefore, if this distance is known, and the time of arrival of the large waves has been noted, it is an easy matter to determine the time at which the preliminary tremors must have arrived. With this factor and with a knowledge of the time at which they originated, their velocity may be calculated. A mean for this is given at 5 or 6 km. per second, whilst a mean value determined from observations is 8 km. per second. In arriving at these results, it must not be overlooked that in certain cases, at least, there has been an unavoidable want of precision in locating origins; the time of occurrence at an origin has been taken as the mean of times observed at stations regarded as being near to the same, and it has been assumed that the waves followed spherical paths. These and other factors have no doubt contributed to the wide limits assigned to the results of these investigations.

In the tenth number of the new series of publications issued by the Earthquake Commission of the Vienna Academy of Sciences, Dr. E. v. Mojsisovics gives a chronological series of notes relating to 157 earthquakes which in 1901 were recorded in various parts of the Austrian Empire. The first of these catalogues, which consists of observations made for the most part without the aid of instrumental appliances, was issued in 1898.

In addition to these lists of local disturbances, which may be compared to the slight shocks which from time to time are felt in this country, the Academy also publishes registers of disturbances which have originated at great distances and shaken the world throughout its mass. Illustrations of these latter are found in the eleventh and twelfth numbers of the publications, the former referring to Trieste and the latter to Kremsmünster.

At the first of these stations, three Rebeur-Ehlert pendulums have been kept at periods of about eight seconds, whilst at the second, similar instruments have periods of from three to four seconds. In 1901, at Trieste, 187 earthquakes were recorded, whilst at Kremsmünster only eighty-one were noted. Although the natural period of the pendulums has

been comparatively short, both stations have suffered from "mikroseismische Unruhe" (air tremors?).

At the present moment the most interesting station where world shaking earthquakes are recorded is at Přibram, where on the surface and at a depth of 1100 m. Wiechert's pendulums are installed. From the few records hitherto obtained, it appears that the motion on the surface and that underground have a striking similarity.

DR. GOELDI ON BRAZILIAN DEER.

Dr. E. Goeldi has decidedly advanced our knowledge of the deer of South America by a memoir on the antlers of three Brazilian species recently published in the *Memorias* of the museum at Para of which he has charge (*Mem. Mus. Goeldi*, part iii., 1902). All South American deer, it need scarcely be said, differ markedly from the more typical deer of the Old World, the males of the larger species, together with their relatives, the white-tailed and the mule deer of North America, being specially distinguished by the form of their antlers, which branch in a fork-like manner some distance above their base, instead of giving off a brow-tine close to the latter. Hitherto naturalists, in Europe at any rate, have had no definite information with regard to the gradual increase in the complexity of the antlers of the South American species as they are annually renewed. This deficiency in our knowledge has been supplied in the case of the marsh-deer, the pampas-deer, and the one commonly called *Cariacus gymnotis*, in the memoir before us. With great pains, Dr. Goeldi has collected a large series of the antlers of each of the three species belonging to animals of different ages, and in the plates accompanying his memoir has figured a selection which serves to display the gradual evolution from the young to the adult form. In the course of the memoir, it is incidentally mentioned that the aforesaid *C. gymnotis*, which is a near relative of the North American whitetail, has only recently made its appearance in Brazil, its proper home being Colombia and Guiana.

THE PEARL FISHERIES OF CEYLON.[1]

The celebrated pearl "oysters" of Ceylon are found mainly in certain parts of the wide shallow plateau which occupies the upper end of the Gulf of Manaar, off the north-west coast of the island and south of Adam's Bridge.

The animal (*Margaritifera vulgaris*, Schum. = *Avicula fucata*, Gould) is not a true oyster, but belongs to the family Aviculidæ, and is therefore more nearly related to the mussels (Mytilus) than to the oysters (Ostræa) of our seas.

The fisheries are of very great antiquity. They are referred to by various classical authors, and Pliny speaks of the pearls from Taprobane (Ceylon) as "by far the best in the world." Cleopatra is said to have obtained pearls from Aripu, a small village on the Gulf of Manaar, which is still the centre of the pearl industry. Coming to more recent times, but still some centuries back, we have records of fisheries under the Singhalese kings of Kandy, and subsequently under the successive European rulers—the Portuguese being in possession from about 1505 to about 1655, the Dutch from that time to about 1795, and the English from the end of the eighteenth century onwards. A notable feature of these fisheries under all administrations has been their uncertainty.

The Dutch records show that there were no fisheries between 1732 and 1746, and again between 1768 and 1796. During our own time the supply failed in 1820 to 1828, in 1837 to 1854, in 1864 and several succeeding years, and finally after five successful fisheries in 1887, 1888, 1889, 1890 and 1891 there has been no return for the last decade. Many reasons, some fanciful, others with more or less basis of truth, have been given from time to time for these recurring failures of the fishery; and several investigations, such as that of Dr. Kelaart (who unfortunately died before his work was completed) in 1857 to 1859, and that of Mr. Holdsworth in 1865 to 1869, have been undertaken without much practical result so far.

[1] Abstract of a discourse delivered at the Royal Institution on March 27 by Prof. W. A. Herdman, F.R.S.

In September, 1901, I was asked to examine the records and report on the matter, and in the following spring was invited by the Government to go to Ceylon with a scientific assistant, and undertake what investigation into the condition of the banks might be considered necessary. Arriving at Colombo in January, 1902, as soon as a steamer could be obtained we proceeded to the pearl banks. In April it was necessary to return to my university duties in Liverpool, but I was fortunate in having taken out with me as my assistant Mr. James Hornell, who was to remain in Ceylon for at least a year longer, in order to carry out the observations and experiments we had arranged, and complete our work. This programme has been carried out, and Mr. Hornell has kept me supplied with weekly reports and with specimens requiring detailed examination.

The s.s. *Lady Havelock* was placed by the Ceylon Government at my disposal for the work of examining into the biological conditions surrounding the pearl oyster banks; and this enabled us on two successive cruises of three or four weeks each to examine all the principal banks, and run lines of dredging and trawling and other observations across, around and between them, in order to ascertain the conditions that determine an oyster bed. Towards the end of the time I took part in the annual inspection of the pearl banks, by means of divers, along with the retiring inspector, Captain J. Donnan, C.M.G., and his successor, Captain Legge. During that period we lived and worked on the native barque *Rangasameeporawee*, and had daily opportunity of studying the methods of the native divers and the results they obtained. [These were discussed in the lecture and illustrated by lantern slides.]

It is evident that there are two distinct questions that may be raised—the first as to the abundance of the adult "oysters," and the second as to the number of pearls in the oysters—and it was the first of these rather than the frequency of the pearls that seemed to call for investigation, since the complaint has not been as to the number of pearls per adult oyster, but as to the complete disappearance of the shell-fish.

Most of the pearl oyster banks or "Paars" (meaning rock or any form of hard bottom, in distinction to "Manul," which indicates loose or soft sand) are in depths of from 5 to 10 fathoms, and occupy the wide shallow area of nearly 50 miles in length, and extending opposite Aripu to 20 miles in breadth, which lies to the south of Adam's Bridge. On the western edge of this area there is a steep declivity, the sea deepening within a few miles from under 10 to more than 100 fathoms; while out in the centre of the southern part of the Gulf of Manaar, to the west of the Chilaw Pearl Banks, depths of between one and two thousand fathoms are reached. On our two cruises in the *Lady Havelock* we made a careful examination of the ground in several places outside the banks to the westward, on the chance of finding beds of adult oysters from which possibly the spat deposited on the inshore banks might be derived. No such beds, outside the known "Paars," were found; nor are they likely to exist. The bottom deposits in the ocean abysses to the west of Ceylon are entirely different in nature and origin from the coarse terrigenous sand, often cemented into masses, and the various calcareous neritic deposits, such as corals and nullipores, found in the shallow water on the banks. The steepest part of the slope, from 10 or 20 fathoms down to about 100 fathoms or more, all along the western coast seems in most places to have a hard bottom covered with Alcyonaria, sponges, deep-sea corals and other large encrusting and dendritic organisms. Neither on this slope nor in the deep water beyond the cliff did we find any ground suitable for the pearl oyster to live upon.

Close to the top of the steep slope, about 20 miles from land, and in depths of from 8 to 10 fathoms is situated the largest of the "Paars," the celebrated Periya Paar, which has frequently figured in the inspectors' reports, has often given rise to hopes of great fisheries, and has as often caused deep disappointment to successive Government officials. The Periya Paar runs for about 11 nautical miles north and south, and varies from one to two miles in breadth, and this—for a paar—large extent of ground becomes periodically covered with young oysters, which, however, almost invariably disappear before the next inspection. This paar has been called by the natives the "mother-

paar," under the impression that the young oysters that come and go in fabulous numbers migrate or are carried inwards and supply the inshore paars with their populations. During a careful investigation of the Periya Paar and its surroundings, we satisfied ourselves that there is no basis of fact for this belief; and it became clear to us that the successive broods of young oysters on the Periya Paar, amounting probably within the last quarter century alone to many millions of millions of oysters, which if they had been saved would have constituted enormous fisheries, have all been overwhelmed by natural causes, due mainly to the configuration of the ground and its exposure to the south-west monsoon.

A study of the history of the Periya Paar for the last twenty-four years [given more fully in the lecture] shows that since 1880 the bank has been naturally restocked with young oysters at least eleven times without yielding a fishery.

The 10-fathom line skirts the western edge of the paar, and the 100-fathom line is not far outside it. An examination of the great slope outside is sufficient to show that the south-west monsoon running up towards the Bay of Bengal for six months in the year must batter with full force on the exposed seaward edge of the bank and cause great disturbance of the bottom. We made a careful survey of the Periya Paar in March, 1902, and found it covered with young oysters a few months old. In my preliminary report I estimated these young oysters at not less than a hundred thousand millions, and stated my belief that these were doomed to destruction, and ought to be removed at the earliest opportunity to a safer locality further inshore. Mr. Hornell was authorised to carry out this recommendation, and went to the Periya Paar early in November with boats and appliances suitable for the work, but found he had arrived too late. The south-west monsoon had intervened, the bed had apparently been swept clean, and the enormous population of young oysters, which we had seen in March, and which might have been used to stock many of the smaller inshore paars, was now in all probability either buried in sand or carried down the steep declivity into the deep water outside. This experience, taken along with what we know of the past history of the bank as revealed by the inspectors' reports, shows that whenever young oysters are found on the Periya Paar, they ought, without delay, to be dredged up in bulk and transplanted to suitable ground in the Cheval district—the region where the most trustworthy paars are placed.

From this example of the Periya Paar it is clear that in considering the vicissitudes of the pearl oyster banks we have to deal with great natural causes which cannot be removed, but which may to some extent be avoided, and that consequently it is necessary to introduce large measures of cultivation and regulation in order to increase the adult population on the grounds, give greater constancy to the supply, and remove the disappointing fluctuations in the fishery.

There are in addition, however, various minor causes of failure of the fisheries, some of which we were able to investigate. The pearl oyster has many enemies, such as star-fishes, boring sponges which destroy the shell, boring Molluscs which suck out the animal, internal Protozoan and Vermean parasites and carnivorous fishes, all of which cause some destruction, and which may conspire on occasions to ruin a bed and change the prospects of a fishery. But in connection with such zoological enemies, it is necessary to bear in mind that from the fisheries point of view their influence is not wholly evil, as some of them are closely associated with pearl production in the oyster. One enemy (a Plectognathid fish) which doubtless devours many of the oysters, at the same time receives and passes on the parasite which leads to the production of pearls in others. The loss of some individuals is in that case a toll that we very willingly pay, and no one would advocate the extermination of that particular enemy.

In fact the oyster can probably cope well enough with its animate environment if not too recklessly decimated at the fisheries, and if man will only compensate to some extent for the damage he does by giving some attention to the breeding stock and "spat," and by transplanting when required the growing young from unsuitable ground to known and trustworthy "paars."

Those were the main considerations that impressed me during our work on the banks, and were, therefore, the leading points dealt with in the conclusions given in my preliminary report (July, 1902), which ended as follows:—

"To the biologist two dangers are, however, evident, and, paradoxical as it may seem, these are *overcrowding* and *overfishing*. But the superabundance and the risk of depletion are at the opposite ends of the life cycle, and therefore both are possible at once on the same ground—and either is sufficient to cause locally and temporarily a failure of the pearl oyster fishery. What is required to obviate these two dangers ahead, and ensure more constancy in the fisheries, is careful supervision of the banks by someone who has had sufficient biological training to understand the life-problems of the animal, and who will therefore know when to carry out simple measures of farming, such as thinning and transplanting, and when to advise as to the regulation of the fisheries."

In connection with cultivation and transplantation, there are various points in structure, reproduction, life-history, growth and habits of the oyster which we had to deal with, and some of which we were able to determine on the banks, while others have been the subject of Mr. Hornell's work since, in the little marine laboratory we established at Galle. [Discussed and illustrated by lantern slides in the lecture.]

Turning now from the health of the oyster population on the "paars" to the subject of pearl formation, which is evidently an unhealthy and abnormal process, we find that in the Ceylon oyster there are several distinct causes that lead to the production of pearls. Some pearls or pearly excrescences on the interior of the shell are due to the irritation caused by boring sponges and burrowing worms. Minute grains of sand and other foreign bodies gaining access to the body inside the shell, which are popularly supposed to form the nuclei of pearls, only do so, in our experience, in exceptional circumstances. Out of the many pearls I have decalcified, only one contained in its centre what was undoubtedly a grain of sand; and from Mr. Hornell's notes, taken since I left Ceylon, I quote the following passage, showing that he has had a similar experience:—

"February 16, 1903—*Ear-pearls*. Of two decalcified, one from the anterior ear (No. 148), proved to have a minute quartz grain (micro. preparation 25) as nucleus."

It seems probable that it is only when the shell is injured, as, for example, by the breaking off or crushing of the projecting "ears," thereby enabling some fine sand to gain access to the interior, that such inorganic particles supply the irritation which gives rise to pearl formation.

The majority of the pearls found free in the tissues of the body of the Ceylon oyster contain, in our experience, the more or less easily recognisable remains of Platyelmian parasites; so that the stimulation which causes eventually the formation of an "orient" pearl is, as has been suggested by various writers in the past, due to infection by a minute lowly worm, which becomes encased and dies, thus justifying, in a sense, Dubois's statement that—"La plus belle perle n'est donc, en définitive, que le brillant sarcophage d'un ver" (*Comptes rendus*, October 14, 1901.)

[The lecturer then dealt with the work of Dr. Kelaart (1859), to whom belongs the honour of having first connected the formation of pearls in the Ceylon oyster with the presence of Vermean parasites, Filippi, Kukenmeister, Moebius, Humbert, Garner, Thurston, Giard, Seurat, Jameson, and finally Dubois—bringing the record up to January, 1903.]

We have found, as Kelaart did half a century ago, that in the Ceylon pearl oyster there are several different kinds of worms commonly occurring as parasites, and we shall, I think, be able to show in our final report that Cestodes, Trematodes, and Nematodes are all concerned in pearl formation. Unlike the case of the European mussels, however, we find, so far, that in Ceylon the most important cause is a larval Cestode of the Tetrarhynchus form. Mr. Hornell has traced a considerable part of the life-history of this parasite, from an early free-swimming stage to a late larval condition in the file fish (*Balistes mitis*) which frequents the pearl banks and preys upon the oysters. We have not yet succeeded in finding the adult, but it will probably prove to infest the sharks or other large Elasmo-

branchs which devour Balistes. It is only due to my excellent assistant, Mr. James Hornell, to state that our observations on pearl formation are mainly due to him. During the comparatively limited time (under three months) that I had on the banks, I was mainly occupied with what seemed the more important question of the life-conditions of the oyster, in view of the frequent depletion of particular grounds. It is important to note that these interesting pearl-formation parasites are not only widely distributed over the Manaar banks, but also on other parts of the coast of Ceylon. Mr. Hornell has found Balistes with its Cestode parasite both at Trincomalie and at Galle, and the sharks also occur all round the island, so that there can be no question as to the probable infection of oysters grown at these or any other suitable localities.

There is still, however, much to find out in regard to all these points, and other details affecting the life of the oyster and the prosperity of the pearl fisheries. Mr. Hornell and I are still in the middle of our investigations, and this must be regarded as only a preliminary statement of results which may have to be corrected, and I hope will be considerably extended in our final report.

It is interesting to note that the *Ceylon Government Gazette* of December 22 last announced a pearl fishery, to commence on February 22, during which the following banks would be fished:

The South-East Cheval Paar, estimated to have 40 million oysters.

The East Cheval Paar, with 11 millions.

The North-East Cheval Paar, with 13 millions.

The Periya Paar Kerrai, with 8 millions—making in all more than 80 million oysters.

That fishery is now in progress, Mr. Hornell is attending it, and we hope that it may result not merely in a large revenue from pearls, but also in considerable additions to our scientific knowledge of the oysters.

As an incident of our work in Ceylon, it was found necessary to fit up the scientific man's workshop—a small laboratory on the edge of the sea, with experimental tanks, a circulation of sea-water and facilities for microscopic and other work. For several reasons [discussed in the lecture] we chose Galle at the southern end of Ceylon, and we have every reason to be satisfied with the choice. With its large bay, its rich fauna and the sheltered collecting ground of the lagoon within the coral reef, it is probably one of the best possible spots for the naturalist's work in eastern tropical seas.

In the interests of science it is to be hoped, then, that the marine laboratory at Galle will soon be established on a permanent basis with a suitable equipment. It ought, moreover, to be of sufficient size to accommodate two or three additional zoologists, such as members of the staff of the museum and of the medical college at Colombo, or scientific visitors from Europe. The work of such men would help in the investigation of the marine fauna and in the elucidation of practical problems, and the laboratory would soon become a credit and an attraction to the colony. Such an institution at Galle would be known throughout the scientific world, and would be visited by many students of science, and it might reasonably be hoped that in time it would perform for the marine biology and the fishing industries of Ceylon very much the same important functions as those fulfilled by the celebrated gardens and laboratory at Peradeniya for the botany and associated economic problems of the land.

W. A. H.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mr. F. C. McClellan has been appointed to the new chair of forestry and estate management at the Royal Agricultural College, Cirencester.

The new science buildings of the Colston's Girls' School, Bristol, will be opened on Friday, May 15, by the Right Hon. Henry Hobhouse, M.P.

We have received a copy of the University of Colorado *Bulletin* for December, 1902. It contains a detailed account of the quarto-centennial celebration held at the end of last year in connection with the University of Colorado, when addresses were delivered by Profs. A. Reed, F. S. Lee, D. C. Jackson, and others.

The Council of the Manchester Literary and Philosophical Society has appointed Mr. A. P. Hunt, sublibrarian of Balliol College, Oxford, to be assistant secretary and librarian to the Society, in succession to Mr. Charles Leigh, who has been appointed deputy librarian of the Owens College, Manchester.

The second volume of the Report of the U.S. Commissioner of Education for the year 1900–1901 runs, like the former part, to more than twelve hundred pages. A large portion of the volume is concerned solely with statistics, and these refer to every grade of education. Uninteresting though these masses of figures are likely to prove to ordinary teachers, they will be found of great value by the student of educational problems. The descriptive article which will most directly appeal to men of science is one on instruction in mining engineering. It appears that the first school of mines in the United States was established in New York City in 1863, in connection with the institution which later developed into the existing Columbia University. At the close of 1901 there were thirty-seven institutions offering courses in mining engineering, two of the courses—those in connection with the University of North Carolina and the University of Texas—having been instituted in 1901. The article also contains short accounts of the systems of instruction in mining in each of the thirty-seven institutions holding courses. A chapter is given to consular reports sent home to the United States by its consuls in different parts of the world, and these reports contain many hints likely to be of practical value to the lecturers and others in American colleges. One chapter appears out of place in an educational report, since it is concerned with the introduction of domestic reindeer into Alaska.

The first part of vol. xiv. of the *Transactions* of the South African Philosophical Society contains an instructive paper by the Rev. Dr. Flint on the legal and economic bases of some colonial teaching universities, which concludes with the local application of the results of the inquiry. The paper summarises the salient facts in the history of the important colonial universities, but it is only possible here to refer to one or two points of interest. The Government of New South Wales voted at its establishment 50,000*l*. for the buildings of Sydney University. An endowment of not more than 20,000*l*., with an annual sum of 500*l*. for the stipend of the principal, was provided for each college incorporated within Sydney University upon the condition that 10,000*l*. at least shall have been subscribed by its founders, the whole to be voted to the erection of buildings on land granted for the purpose. New Zealand University has also been generously treated by its Government, from which source it receives an annual grant of 3000*l*. But in addition to this the four affiliated colleges have received land grants to the extent of 40,000 acres, and Otago, for instance, receives in rent from lands granted in this way about 6500*l*. per year. Similarly, the University of Adelaide received from South Australia a grant of 50,000 acres. The University of Melbourne appears to receive in Government grants some 13,500*l*. It is well that these examples, which do not by any means exhaust the instances given in the paper, should be brought prominently before the people of South Africa, in view of the growing feeling that a worthy teaching university for the whole of South Africa is much needed.

The annual discussion before the Washington meeting last January of the American Society of Naturalists dealt with the question: How can endowments be used most effectively for scientific research? The speeches on this occasion are printed in *Science* for April 10. Prof. T. C. Chamberlin advocated the special endowment of chairs of research. There ought no longer, he said, to be a struggle on the part of the capable investigator to free himself from obligations to teach that he may devote himself to creative work. From 20,000*l*. to 40,000*l*. would effectively endow a chair of research, though Prof. Chamberlin argued later that the endowment should be made to the department rather than a specific chair, thus distributing the function of research among the members of the staff according to

their capabilities and tastes. Prof. W. M. Wheeler showed how large a part of the value of fellowships was lost to research by expecting fellows to perform extraneous duties and to do their research always at a given institution. Prof. Münsterberg insisted that the only two factors which really count for research are to be found in the minds of the men engaged upon it; they are, first, intellectual quality, and secondly, the will to achieve. In these two respects he maintained American research to be defective. He urged the men of wealth who had millions ready for endowment first to make the career of research attractive, so that more men of first-class type may be tempted, and to create great premiums by putting above the present university system a still higher institution, an over-university where the finest masters of research, chosen by their peers, are brought together for far-reaching work which transcends the possibilities of the educational institutions. Whatever can be done to give the career national glory thus to attract the finest men will be productive for the work of research. To secure that able men shall do their best work he advised the following course:—Make the academic career in the real universities, the promotion to higher positions, dependent in first line upon research work, as it is in Germany, and the work will be done, in spite of all obstacles. There is at present no greater educational need than to educate the trustees and benefactors of universities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 26.—"Some Physical Properties of Nickel Carbonyl." By James **Dewar**, M.A., Sc.D., LL.D., F.R.S., and Humphrey Owen **Jones**, M.A., B.Sc.

The authors' communication gives an account of the investigation of a number of the physical properties of nickel carbonyl which have hitherto been investigated only to a slight extent.

It was found that the compound in the gaseous state was much more stable than it had hitherto been supposed to be, and that no explosion took place when the vapour was suddenly heated, provided that oxygen was not present in the surrounding gas. When the vapour was decomposed by heat the products of dissociation were nickel and carbon monoxide; at temperatures below 180° C. only traces of carbon dioxide could be detected, so that the decomposition postulated by Berthelot to explain the explosion of the vapour does not take place to any appreciable extent.

A large number of vapour density determinations were made by Victor Meyer's method at a number of temperatures between 63° C. and 216° C. in an atmosphere of various inert gases (hydrogen, nitrogen and ethylene), and also in carbon monoxide.

The effect of temperature, of rate of admixture of the vapour with the surrounding gas by diffusion, and of the presence of one of the products of dissociation on the extent of the dissociation is very clearly seen from the numerical values and the curves.

A number of determinations of the vapour-density at various temperatures under reduced pressure were made, and also show the marked effect of temperature on the dissociation. The dissociation becomes practically complete only at the boiling point of aniline.

The critical temperature was found to be about 200° C., and the critical pressure was estimated to be about thirty atmospheres.

A number of vapour-pressure determinations were made by the statical method over a range of temperature between −9° C. and +30° C. From the values obtained, the Rankine formula gives the following relation between the absolute temperature T and the pressure p in millimetres of mercury:—

$$\log p = 7{\cdot}355 - 1415/T.$$

The results are compared with those obtained by Mittasch by the dynamic method.

Various constants are calculated from the results obtained, and these are found in several cases to be very similar to the corresponding constants for ether. The latent heat of vaporisation is 38·1 calories per gram, and the Trouton constant is 20·6. The molecule of nickel carbonyl appears to be 4.2 times larger than that of carbon monoxide.

Some experiments which were made show that the reaction between carbon monoxide and nickel is reversible, and proceeds rapidly at the ordinary temperature, and with a measurable velocity at very low temperatures.

Royal Microscopical Society, April 15.—Dr. Hy. Woodward, F.R.S., in the chair.—Mr. F. W. **Millett's** report on the recent Foraminifera of the Malay Archipelago collected by Mr. A. Durrand, part xiv., was taken as read.—The secretary read a paper by Mr. E. B. **Stringer** on a new method of using the electric arc in photomicrography. The method consists in employing the radiation of the electric arc itself altogether separated from the incandescent carbons. This, modified by certain light filters, yields a powerful violet monochromatic light on the extreme limit of visibility. The separation is effected by the substage diaphragm, the opening in which is adjusted so as to allow only the radiation of the arc to pass. A trough containing a solution of ammoniated sulphate of copper suppresses all but the violet band, and the ultra-violet rays are intercepted by another trough containing a solution of sulphate of quinine. Lantern slides of *Pleurosigma angulatum*, dry, and *Coscinodiscus asteromphalus* in styrax, taken with a Zeiss 3 mm. oil immersion apochromatic objective of 1·4 N.A. and 8 compensating eye-piece giving a magnification of 2200 diameters, were shown upon the screen. The author discussed the possibility of obtaining lenses corrected for the ultra-violet rays which would enable photography to do for the microscope what it had already done for the telescope. Three slides of *Navicula bombus* were shown on the screen to demonstrate the advantage of using the troughs containing solutions of ammoniated sulphate of copper and sulphate of quinine.—Dr. R. **Hamlyn-Harris** sent a description of an apparatus for facilitating the manipulation of celloidin sections. The apparatus consisted of a circular vessel 3½" diameter and ½" deep outside. The body is made of a non-corroding metal, and the bottom of brass. It is divided into twenty compartments; in each compartment are perforations to allow fluid to escape when the transfer is made from one fluid to another. The apparatus suggested itself to the writer's mind in consequence of the difficulties experienced by him in preparing, staining, and mounting a series of celloidin sections in successive order.—Mr. C. F. **Rousselet** exhibited about two dozen mounted slides of Rotifers of the genus Brachionus. The specimens, besides those collected in England, came from America, Asia Minor, Bohemia, China, Germany, and Hungary, and comprised sixteen species, including one not yet described, and a number of varieties. The author mentioned that the *B. reubens* exhibited was the true species of Ehrenberg, and different from the one figured under that name in Hudson and Gosse's monograph.

PARIS.

Academy of Sciences, April 20.—M. Albert Gaudry in the chair.—Statistics of the minor planets. The distribution of the elements taking the aphelia as the argument, by M. O. **Callandreau.** The aphelia distances arrange themselves symmetrically about their mean value in a manner resembling the arrangement of accidental errors.—On spirillosis in the Bovidæ, by M. A. **Laveran.** An account, with drawings, of the detailed examination of the blood of Transvaal cattle infected with spirilla. These parasites have always been found in the blood of cattle associated with other organisms. At the present time only two diseases are definitely known to be produced by spirilla, the relapsing fever caused by *Sp. Obermeieri*, peculiar to man, and the spirillosis produced by *Sp. anserinum*. The parasite described in the present paper forms a new species, to which the name *Sp. Theileri* is given.—On the integration of differential equations of the second order with constant coefficients, by M. E. **Vallier.**—The specific heats and heats of vaporisation and of fusion of aniline and some other organic compounds, by M. **de Forcrand.** The specific heat of aniline in the solid and liquid state and of the latent heat of fusion has been determined by the method of mixtures. Measurements are also given for nitrobenzene, benzene, and acetic acid.—Photographic observation of the eclipse of the moon on April 11, 1903, at the Observatory of Toulouse, by M. **Montangerand.** The atmospheric conditions on the night of the eclipse were

very favourable, eleven negatives being obtained.—Observation of the lunar eclipse of April 11–12, 1903, by M. R. **Mailhat.** Eighteen negatives were taken and submitted to the Academy.—On M. Guichard's new transformation of surfaces of total constant curvature, by M. **Tzitzéica.**—On a new generalisation of the theorem of M. Picard on entire functions, by M. Georges **Remoundos.** Researches on electric convection, by MM. V. **Crémieu** and H. **Pender.** In spite of the contradictory nature of some of the experimental results obtained, the authors believe that they are justified in drawing the conclusion that charged metallic surfaces, either continuous or divided into sectors, and turning in air in their own plane, produce magnetic effects in the sense predicted by electric convection, and agreeing within 10 per cent. with the order of magnitude calculated for convection. The interposition of fixed armatures between the moving surfaces and the measuring apparatus appears to have no influence on the magnetic effects obtained.—On magnetic hysteresis at high frequencies, by MM. C. E. **Guye** and B. **Herzfield.** The question has frequently been raised as to whether the energy lost by hysteresis in a magnetic cycle is independent of the speed with which the cycle is completed, and very contradictory results have hitherto been published. The chief cause of uncertainty is the presence of Foucault currents, and in the experiments described in the present paper an attempt has been made to eliminate this difficulty by the use of very fine iron wires, and a thermal method for measuring the energy dissipated in the wire has been adopted. Up to 1200 periods per second the energy consumed by hysteresis is independent of the velocity of the cycle.—On the magnetic properties of the terrestrial atmosphere, by M. Charles **Nordmann.** The magnetic properties of the atmosphere can only have a very small effect on the earth's magnetic field, and can only produce a negligible fraction of the diurnal period of a magnetised needle.—On electric sparks, by M. B. **Eginitis.**—The electrical separation of metallic powders and inert material, and of the metallic part of a mineral from its gangue, by M. D. **Negreano.**—On a self-registering galvanometer and a rotating contact, and their use in tracing the curves of alternating currents, by M. J. **Charpentier.** The mechanism controlling the introduction and motion of the sheet of paper upon which the curve is to be drawn is the chief characteristic of the recording galvanometer for which novelty is claimed.—The nature of the sulphur compound in the water from the Bayen spring at Bagnères-de-Luchon, by M. F. **Garrigou.** The Bayen water, before contact with air, contains a sulphydrate of sulphur.—Soluble cellulose, by M. Léo **Vignon.** Oxycellulose, prepared from cellulose by means of hydrochloric acid and potassium chlorate, is acted upon by aqueous solutions of potash in the cold, with regeneration of cellulose and forming a soluble cellulose, which can be precipitated from the solution by hydrochloric acid, or chlorides of the alkalis and alkaline earths. Physiological and histological observations on the Gephyrians (endothelial derivatives and pigmentary granules), by M. Marcel A. **Hérubel.**—On the existence of an axile filament in the adult conjunctival fibrilla, by M. P. A. **Zachariadès.**—Indophil reaction of the leucocytes in the aseptic suppurations caused by the subcutaneous injection of essence of turpentine, by MM. J. **Sabrazès** and L. **Muratet.**

DIARY OF SOCIETIES.

THURSDAY, April 30.

Royal Society, at 4.30.—Croonian Lecture: The Cosmical Function of the Green Plant: Prof. K. A. Timirjazev.

Royal Institution, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

Institution of Electrical Engineers, at 8.—Divided Multiple Switchboards: An Efficient Telephone System for the World's Capitals: W. Aitken.

FRIDAY, May 1.

Royal Institution, at 9.—Recent Advances in Stereochemistry: Prof. W. J. Pope.

Geologists' Association, at 8.—The Zones of the White Chalk of the English Coast. IV.—Yorkshire: Dr. A. W. Rowe.

MONDAY, May 4.

Society of Chemical Industry, at 8.—Problems in the Fat Industry: Dr. Julius Lewkowitsch.

Society of Arts, at 8.—Mechanical Road Carriages: W. Worby Beaumont.

Victoria Institute, at 4.30.—Report on the Congress of Orientalists held at Hamburg, together with a Short Description of the Laws of Hammurabi, the Amraphel of Genesis, Ch. xiv., as Engraved on the Recently Discovered Monument: Dr. T. G. Pinches.

TUESDAY, May 5.

Royal Institution, at 5.—The Blood and some of its Problems: Prof. Allan Macfadyen.

Society for the Promotion of Hellenic Studies, at 4.30.

Society of Arts, at 4.30.—The Lagos Hinterland: its People and its Products: Major J. H. Ewart.

WEDNESDAY, May 6.

Entomological Society, at 8.—Descriptions of twelve New Genera and Species of Ichneumonidæ and three New Species of Ampulex from India: Peter Cameron.

Society of Public Analysts, at 8.

Society of Arts, at 8.—The Construction of Maps and Charts: G. J. Morrison.

THURSDAY, May 7.

Royal Society, at 4.30.—*Probable Papers*:—On *Lagenostoma Lomaxi*, the Seed of Lyginodendron: Dr. F. W. Oliver and Dr. D. H. Scott, F.R.S.—On the Physiological Action of the Poison of the Hydrophidæ: Dr. L. Rogers.—Preliminary Note on the Discovery of the Pigmy Elephant in Cyprus: Miss D. M. A. Bate.

Royal Institution, at 5.—Hydrogen: Gaseous, Liquid and Solid: Prof. Dewar, F.R.S.

Röntgen Society, at 8.30.—Exhibition Evening.

Chemical Society, at 8.—(1) β-Bromonitrocamphor and β-Bromocamphoryloxime. Influence of Impurities in Conditioning Dynamic Isomerism; (2) Spontaneous Decomposition of Nitrocamphor: T. M. Lowry.—The Active Constituents of *Butea frondosa*: E. G. Hill.

Linnean Society, at 8.—The Ingolfiellidæ, fam. nov., a New Type of Amphipoda: Dr. H. J. Hansen.—The Evolution of the Marsupials of Australia: A. Bensley.—Copepoda Calanoida from the Faröe Channel, and Other Parts of the North Atlantic: Rev. Canon Norman, F.R.S.

Institution of Electrical Engineers, at 8.—Applications of Electricity in Engineering and Shipbuilding Works: A. D. Williamson.—Electric Driving in Machine Shops: A. B. Chatwood.

FRIDAY, May 8.

Royal Institution, at 9.—Rural England: H. Rider Haggard.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—On the Necessity of Examining and Comparing the Animals before Determining some Species of the Genus Oliva: F. G. Bridgman.—Notes on some British Eulimidæ: E. R. Sykes.—Note on the Occurrence of *Planorbis marginatus*, Drap., and *Limnaea pereger*, Müll., in the Pleistocene of Bognor, Sussex: Alexander Reynell.

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